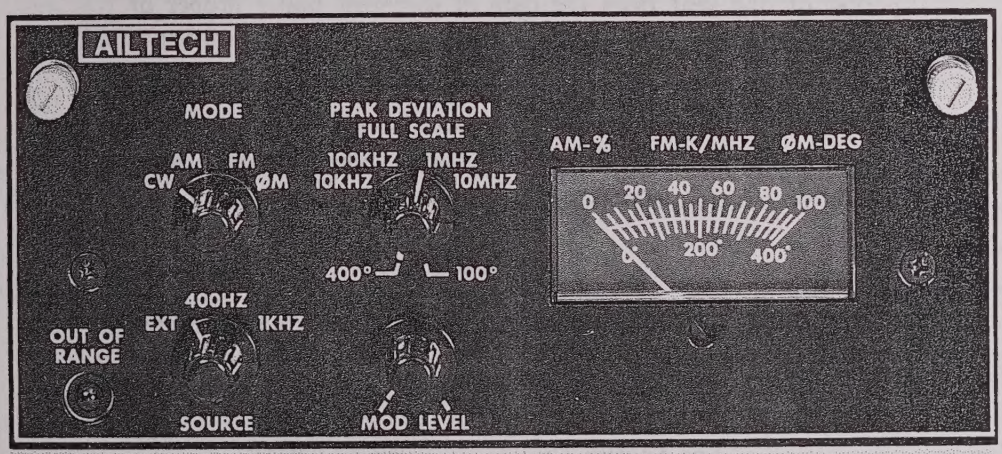
OPERATION AND MAINTENANCE MANUAL

AILTECH

PM 3602 AM/FM/PHASE MODULATION SECTION



PM3602 AM/FM/PHASE MODULATION SECTION

MARCH 1981

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Ronkonkoma, New York 11779

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SECTION 1

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. The AILTECH PM3602 AM/PM/Phase Modulation Section is a subordinate plug-in assembly for use with the 360D11 and 380K11 Synthesizer Mainframe, the 3600E1 Frequency Extender, and operates in conjunction with the P360180E1, P3601.8E1 or P3602.0E1 RF Section. Figure 1-1 shows the PM3602 Modulation Section installed in a P3602.0E1 RF Section.

1-3. This manual contains installation, operation, and maintenance information for the PM3602 AM/FM/Phase Modulation Section and is divided into five sections as follows:

Section 1, GENERAL INFORMATION, provides a brief description, pertinent specifications, a list of accessories, component subassemblies, and test equipment required for operation and maintenance of the PM3602 Modulation Section.

Section 2, INSTALLATION, provides information necessary for unpacking, preparation for use, and initial checkout.

Section 3, OPERATION, provides operating instructions for the PM3602 Modulation Section as used in conjunction with the Frequency Synthesizer to obtain a desired output. It also contains a simple operator maintenance procedure.

Section 4, MAINTENANCE, provides all information necessary to troubleshoot, repair and calibrate the PM3602 Modulation Section.

Section 5, REPLACEABLE PARTS LIST, provides a complete list of all electronic parts contained in the PM3602 Modulation Section.

1-4. DESCRIPTION

1-5. The PM3602 is a fully programmable AM/FM/ØM Modulation Section which readily attaches to the front of either the P360180E1, the P3601.8E1 or P3602.0E1 RF Section, giving the AILTECH 360 or 380 complete modulation capability to 2000 MHz. All modulation functions of the PM3602 are fully programmable in parallel code. Also, mainframe Option 005 Interface Bus Adapter is available which converts all the functions of the 360 Frequency Synthesizer, including modulation functions, to the IEEE 488 Interface Bus.

1-6. Modulation mode (CW, AM, FM or ØM), modulation level, modulating signal source (400 Hz, 1 kHz or external source) and meter range are selected and controlled by front panel controls and indicators. RF power output is controlled by the RF section. Specifications for the PM3602 Modulation Section are listed in Table 1-1.

Table 1-1. PM3602 Modulation Specifications

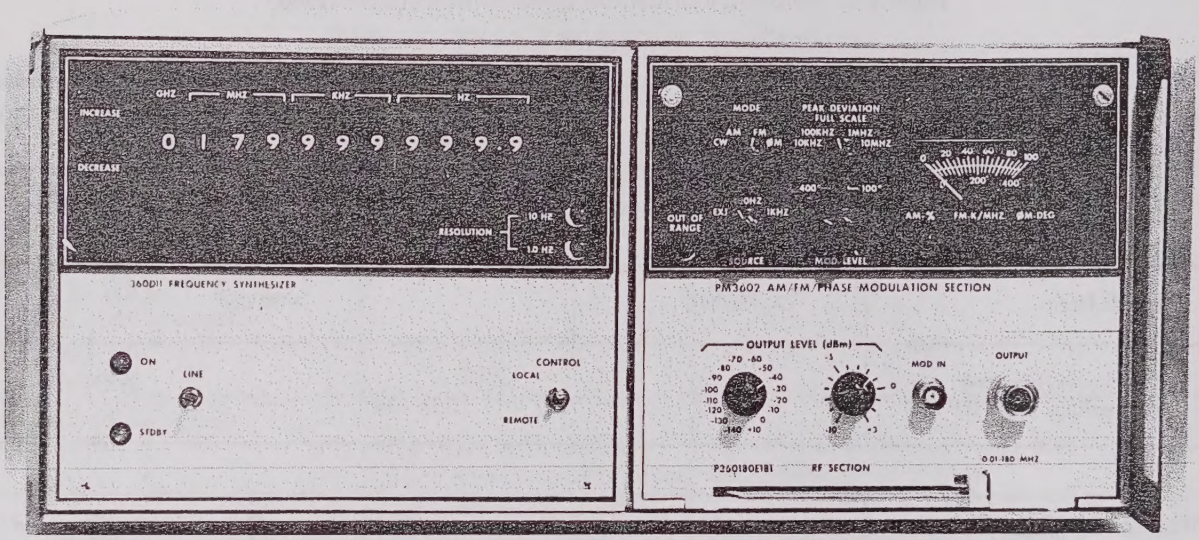
AMPLITUDE MODULATION	P360180E1 .01 - 180 MHz	P3601.8E1 1 - 1800 MHz	P3602.0E1 1 - 2000 MHz
Modulation Depth	0 - 95%	0 - 90%	
Indicated AM Accuracy at 400 and 1000 Hz Rates	±5% of Full Scale (100%)	±5% of Full Scale (100%)	
AM Distortion, THD. 400 and 1000 Hz Rates 30% AM 90% AM	 1.0% 3.0%	 1.0% 5%	
AM 3 dB Bandwidth 0 - 70%	 DC - 200 Hz, CF <0.4 MHz DC - 10 kHz, 0.4≤CF<4 MHz DC - 100 kHz, CF > 4 MHz	 DC - 10 kHz, 2 MHz < CF < 10 MHz DC - 80 kHz, CF ≥ 10 MHz	
0 - 90%	DC - 100 Hz, CF < 0.4 MHz DC - 5 kHz, 0.4 ≤ CF 4 MHz DC - 50 kHz, CF ≥ 4 MHz	DC - 5 kHz, 2 MHz < CF < 10 MHz DC - 50 kHz, CF ≥ 10 MHz	
Internal Oscillator	400 and 1000 Hz	400 and 1000 Hz	
Remote Programming	Fully programmable, external modulation input level is 1.0 VRMS for full scale.		
Programming Resolution	0.5% Increments		

FREQUENCY MODULATION	P360180E1 .01 - 180 MHz	P3601.8E1 1 - 1800 MHz	P3602.0E1 1 - 2000 MHz
Rate	20 Hz to 300 KHz		
FM Center Frequency Long Term Stability	Same as in CW Mode		
Maximum Peak Deviation	1 MHz	1 MHz, CF <320 MHz 10 MHz, CF≥320 MHz	1 MHz, CF <400 MHz 10 MHz, CF≥ 400 MHz
Incidential AM	< -70 dB with 75 KHz peak deviation at 1 KHz rate		
FM Distortion (Internal Oscillator)	<2% up to 100 KHz deviation	<2% up to 100 KHz dev. for CF <320 MHz <2% up to 1 MHz dev. for CF ≥320 MHz	
Internal Oscillator	400 and 1000 Hz		
Full Scale Ranges	0 - 10 KHz, 0 - 100 KHz, 0 - 1 MHz, 0 - 10 MHz		
Indicated FM Accuracy (up to 20 KHz rates)	±5% of Full Scale Range		
Remote Programming	Modes, range, and level. External modulation input level is 1.0 VRMS for full scale.		
Programming Resolution	0.5% of Selected Range		

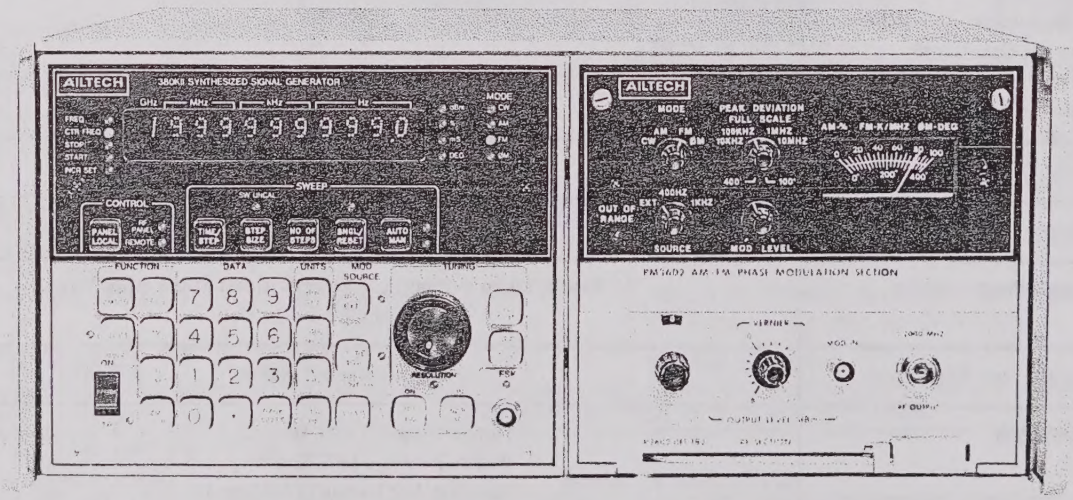
Table 1-1. PM3602 Modulation Specifications (Continued)

PULSE MODULATION	P360180E1 .01 - 180 MHz	P3601.8E1 1 - 1800 MHz	P3602.0E1 1 - 2000 MHz
Rise/Fall Time	< 5 μs		
On/Off Ratio	> 70 dB	> 30 dB	
Input Level Required (Neg. voltage turns RF off)	0 to -5V		

PHASE MODULATION	P360180E1 .01 - 180 MHz	P3601.8E1 1 - 1800 MHz	P3602.0E1 1 - 2000 MHz
Rate	DC to 300 kHz		
Maximum Peak Deviation	100°, CF <60 MHz 200°, CF ⩾60 MHz	100°, CF <80 MHz 200°, 80 to 160 MHz 400°, CF ⩾160 MHz	100°, CF <100 MHz 200°, 100 to 200 MHz 400°, CF > 200 MHz
ØM Distortion (Internal Oscillator)	< 5%		
Internal Oscillator	400 and 1000 Hz		
Full Scale Ranges	0 - 100°, 0 - 400°		
Indicated Accuracy	±5% of Full Scale Range		
Remote Programming	Mode, range and level. External modulation input level is 1.0 vrms for full scale.		
Programming Resolution	0.5% of Selected Range		
Dimensions	Height 4 inches (10.16 cm) Width 7 inches (17.78 cm) Depth 4 1/2 inches (11.43 cm) Weight Net 3 pounds (1.36 kg) Weight Shipped 4 pounds (1.81 kg)		



360 SYNTHESIZED SIGNAL GENERATOR



380 SYNTHESIZED SIGNAL GENERATOR

Figure 1-1. PM3602 AM/FM/Phase Modulation Section Shown Mounted in 360 and 380 Synthesizers

1-7. ACCESSORIES

1-8. Service kit part number 299252 is available for maintenance purposes, see Figure 1-2. Table 1-2 lists the items contained in the kit. The items marked with an asterisk are applicable to the PM3602 Modulation Section.

1-9. TEST EQUIPMENT

1-10. Table 1-3 lists the test equipment recommended for use in testing, adjusting, and servicing the PM3602 Modulation Section.

1-11. PM3602 MODULATION SECTION ASSEMBLIES AND SUBASSEMBLIES

1-12. The PM3602 Modulation Section consists of four major assemblies designated A1 through A4. Table 1-4 lists the reference designation, name, and part number of the assemblies and subassemblies contained in the PM3602 Modulation Section.

Table 1-2. Service Kit Part No. 299252

Item	Description	Part Number
	Pouch Assembly	299252-4
1*	Adjustment Tool Non-Metallic	293198-1
2	Card Jumper, BCD	299225
3	Card Extender, BCD	299545
4	Card Extender, Power Supply	299547
5	Adjustment Tool	293198-2
	Pouch PI Extender Cable	299252-4
6	Extender Cable Assembly	299822
7	Extraction Tool M Block	294291
8	Extender Cable MPU	296551-1
9	Extender Cable MPU	296551-2
	Pouch Jumper Cable	299252-6
10	Cable Assembly, Jumper Mainframe	299821
	Pouch Assembly Modulation Extender Cable	299252-7
11*	Cable Assembly Extender Modulation	299820
	Pouch Assembly RF Cable	299252-8
12*	Cable Assembly, Coaxial, SMB Plug to SMB Plug Quantity 2	299543-1

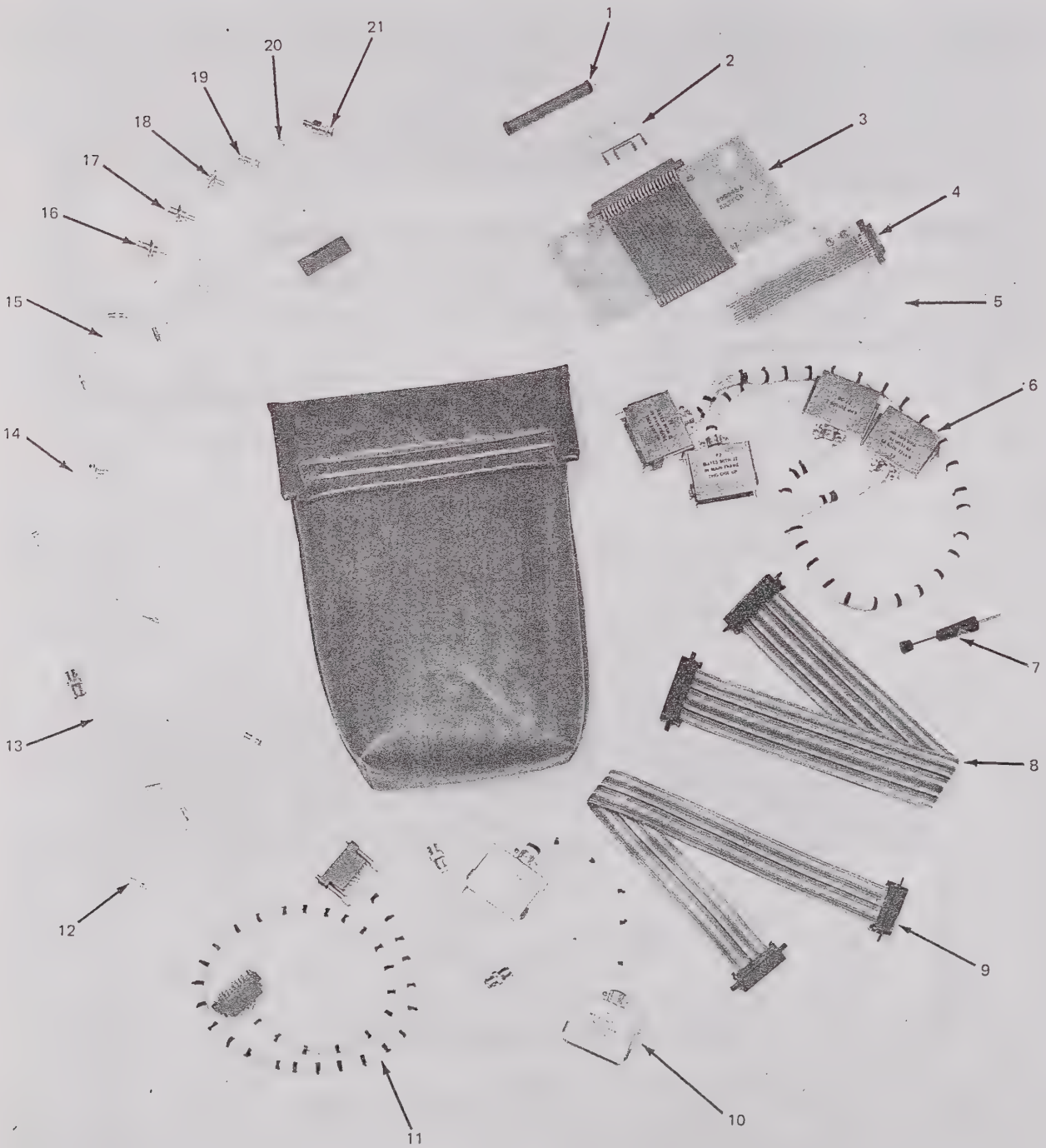


Figure 1-2. Service Kit Part No. 299252

Table 1-2. Service Kit Part No. 299252 (Continued)

Item	Description	Part Number
13*	Cable Assembly, Coaxial, SMB Plug to SMB Plug Quantity 2	299543-2
14*	Cable Assembly, Coaxial, SMB Right Angle Plug to SMB Right Angle Plug	299543-3
15*	Cable Assembly, Coaxial SMB Jack to SMB Plug, Quantity 2	299543-4
	Case Assembly, RF Adapter	299252-9
16*	Adapter BNC Female, SMB Jack	294676
17*	Adapter BNC Female, SMB Plug	294677
18*	Adapter SMB Tee	294678
19	Adapter Straight Jack/Jack	294652
20	Adapter Straight Plug/Plug	294653
21	Adapter OSM Jack to Type BNC Jack	294658

*Specifically required for PM3602 Modulation Section

Table 1-3. Recommended Test Equipment

Equipment	Manufacturer
Digital Voltmeter	Systron Donner 7004
Frequency Counter	Dana 7720
Spectrum Analyzer	AILTECH 757
Oscilloscope	Tektronix 454
Function Generator	Wavetek 142
Insulated board to protect Modulator	
Adapter, SMB Tee	AILTECH 294678
Cable Assembly	AILTECH 299543-3
Adapter BNC Female to SMB Plug	AILTECH 294677

Table 1-4. Modulator Section Assemblies And Subassemblies

Reference Designation	Title	Part Number
1A1	Modulation Control	295236
1A1A1	Switch Combiner	295232
1A1A2	Phase Modulator	295211
1A1A3	Modulation Oscillator	295242
1A2	Phase Lock Loop	295237
1A2A1	29 MHz Oscillator	295273
1A2A2	Divider	295213
1A2A3	Phase Detector	295207
1A3	Bezel Assembly	295238
1A4	Control	295234

SECTION 2

INSTALLATION

2-1. INTRODUCTION

2-2. This section contains unpacking instructions, preparation for use, and initial checkout of the PM3602 Modulation Section.

2-3. UNPACKING

2-4. No special instructions or precautions are necessary for unpacking when the Modulation Section is shipped installed in a RF Section within a mainframe. If the Modulation Section is ordered and shipped separately, reasonable care should be exercised in removing the equipment from its packing container to prevent damage to the alignment pins on the plug-in connector.

CAUTION

Do not attempt to assemble the Modulation Section to the RF Section if the connector alignment pins are bent, since this could cause extensive damage to the plug-in connector.

2-5. PREPARATION FOR USE

2-6. If the Modulation Section was ordered and shipped with an RF Section, the two units are assembled at the factory prior to shipment. Physically the Modulation Section is the upper half of the RF Section front panel. If the Modulation Section is assembled to the RF Section, proceed to paragraph 2-8.

2-7. The Modulation Section is more readily installed with the RF Section either completely removed from or partially inserted in the mainframe. To install the Modulation Section proceed as follows:

1. Insert modulation interface connector P3 through the front panel opening, and partially set the connector in mating connector J3 on the RF Section. Secure the connector by finger-tightening the captive thumbscrews on connector P3.
2. Place the lower edge of the Modulation Section panel on the upper edge of the RF Section panel. Make certain the metal tab on the Modulation Section panel is behind the RF Section panel.
3. Pivot the panel back into the recess provided. Secure the unit by finger-tightening the captive thumbscrews on the Modulation Section front panel, and fasten the rear bracket with the screw provided.

2-8. To install the RF Section to the mainframe, perform the following:

1. Carefully slide the unit about halfway into the slot provided on the right side of the mainframe.
2. Making certain the locking lever is at about a 45 degree angle with the front panel; seat the unit. The locking lever should pivot in towards the panel.
3. Lock the plug-in in place by depressing the lever until the latch engages.

2-9. INITIAL TURN-ON

2-10. Refer to Section 3 for the location and function of controls, indicators, and connectors on the Modulation Section; and the 360D11 Mainframe handbook or 380K11 Mainframe Handbook, the P360180E1, P3601.8E1, P3602.0E1 Plug-In Section Handbooks for location and function of other controls, indicators, and connectors referred to in the following procedure.

CAUTION

To prevent damage to the instrument, select line voltage before connecting power. Also ensure that the power cord is connected to a power circuit with a protective earth ground.

1. Set the power switch S1 at the rear of the Frequency Synthesizer to 115 or 230 volts to coincide with the power source.
2. Set LINE switch on the Frequency Synthesizer front panel to STDBY.
3. Set CONTROL switch to LOCAL.
4. Connect the power cable at the rear of the Frequency Synthesizer to an uninterrupted source of 115/230 V, single-phase, 48 to 66 Hz power. The STDBY light on the front panel should go on.
5. Allow a minimum of 1 hour warmup period for the Frequency Synthesizer.

2-11. INITIAL CHECKOUT

2-12. After the 1 hour warmup period, perform the following checks:

1. Connect RF OUTPUT of Frequency Synthesizer to AILTECH 757 Spectrum Analyzer. Set analyzer to 100 MHz center frequency at 1 MHz/cm and IF Bandwidth (KHz) control to [AUTO] position.
2. Set Frequency Synthesizer to LOCAL mode and select an output frequency of 100.0000000 MHz at an output of +7 dBm.
3. Set Modulator MODE switch to CW. A 100 MHz signal with no modulation should be present at the analyzer.

4. Set Modulator MODE switch to FM. Set PEAK DEVIATION FULL SCALE switch to 1MHZ, and SOURCE switch to 1KHZ. Adjust MOD LEVEL control for a 100 meter reading. A frequency modulated carrier should be present at the analyzer centered at 100.000 MHz and deviating ± 1 MHz.

5. Switch analyzer to 100 kHz/cm and set PEAK DEVIATION FULL SCALE switch to 100KHZ. An FM modulated signal should be present at the analyzer deviating ± 100 kHz.

6. Switch analyzer to 10 kHz/cm and change PEAK DEVIATION FULL SCALE switch to 10KHZ. An FM modulated signal should be present at the analyzer deviating ± 10 kHz.

7. Connect Function Generator, Wavetek 142 or equivalent, to the MOD IN connector. Insure that there is no dc offset present on the function generator signal, otherwise the deviation meter readings will be incorrect. Set the generator for 1 volt rms output at 20 kHz. Set Modulator SOURCE switch to EXT and set analyzer to 30 kHz/cm.

8. Set MODE switch to ØM and PEAK DEVIATION FULL SCALE switch to 400°. A phase modulated signal should appear at the analyzer. Adjust MOD LEVEL control until the carrier is at minimum. This should occur when the meter indicates 138° peak ± 10°.

9. Change RF output frequency to 50.0000000 MHz at +7 dBm, and observe the second harmonic, 100 MHz on the analyzer. Set PEAK DEVIATION FULL SCALE switch to 100°, and adjust MOD LEVEL control for a carrier null. This should occur when the meter indicates 69° peak ± 5°.

10. Position MODE switch to AM and rotate MOD LEVEL control to 50% indication on meter. The analyzer should indicate AM sidebands 50 kHz away from the carrier at 12 ± 1 dB below the carrier level.

SECTION 3

OPERATION

3-1. INTRODUCTION

3-2. This section describes and illustrates controls, indicators, and connectors and provides operating instructions for the PM3602 Modulation Section. A simple operational check is also provided in the event of a suspected malfunction.

3-3. CONTROLS, INDICATORS, AND CONNECTORS

3-4. Figure 3-1 shows the controls, indicators, and connectors on the front and rear panel of the Modulator Section. Table 3-1 lists the exact name of the control, reference designation, and function.

3-5. ANCILLARY EQUIPMENT

3-6. The AILTECH PM3602 Modulation Section is used in conjunction with the P360180E1, P3601.8E1 and P3602.0E1 RF Sections and the 360D11 and 380K11 Frequency Synthesizer Mainframe and 3600E1 Frequency Extender as a precision signal source.

Table 3-1. PM3602 Modulation Section Controls, Indicators and Connectors

Figure 3-1 Index No.	Control and Indicator	Reference Designation	Function
1	MODE Switch, CW, AM, FM, ØM	A3S3	Use to select CW (continuous wave), AM (amplitude modulation), FM (frequency modulation) or ØM (phase modulation) of RF carrier wave.
2	PEAK DEVIATION FULL SCALE Switch 10KHZ, 100KHZ, 1MHZ, 10MHZ, 400°, 100°	A3S2	Sets full scale deflection of meter A3M1 for 10KHZ, 100KHZ, 1MHZ, 10MHZ, 100° or 400°.
3	Meter, AM-%, FM-K/MHZ, ØM-DEG Modulation	A3M1	Provides indication of percent of AM modulation, FM peak deviation, or ØM peak modulation between 0 and full scale value as determined by setting of PEAK DEVIATION FULL SCALE switch A3S2.

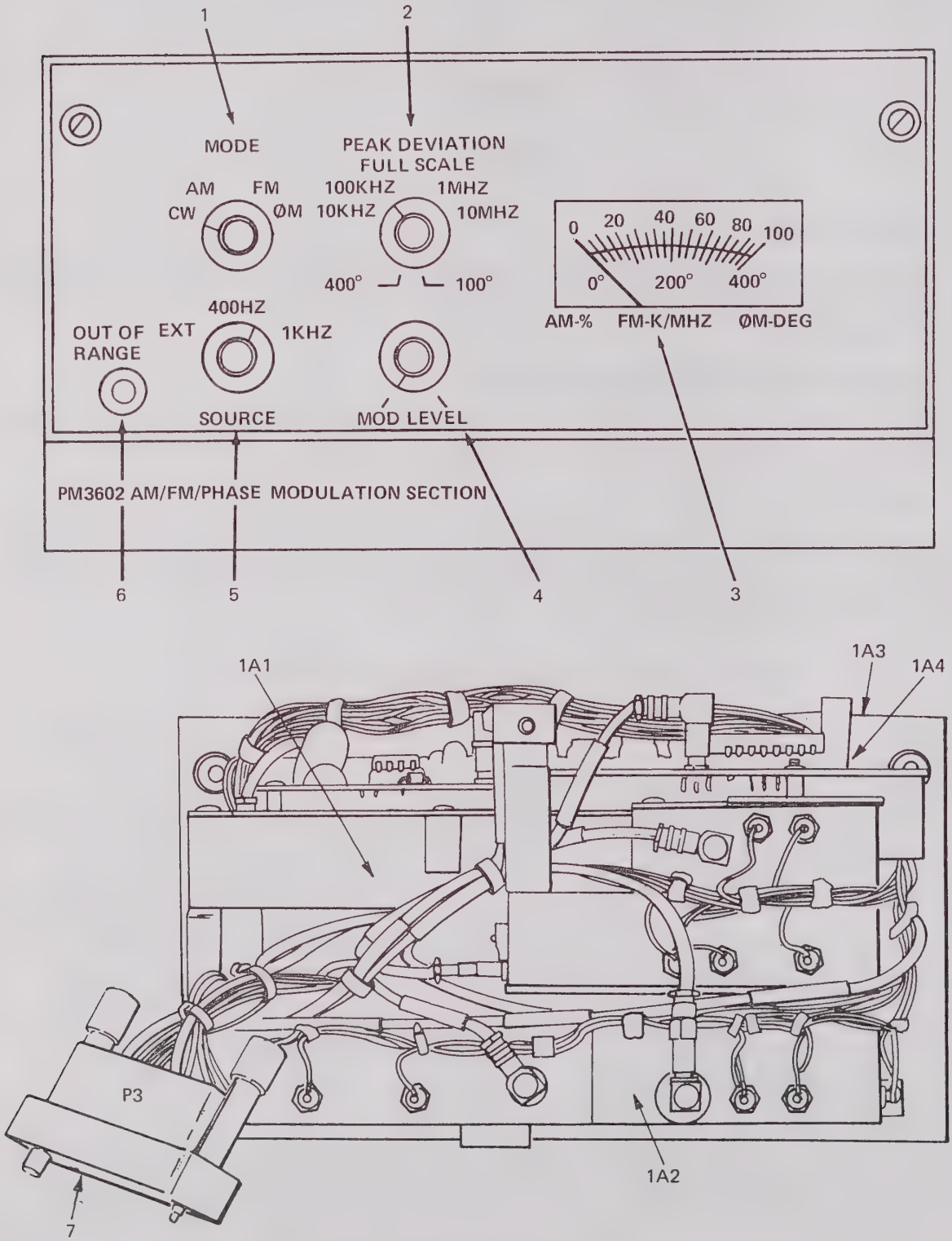


Figure 3-1. PM3602 AM/FM/Phase Modulation Section Front and Rear Panel Controls, Indicators and Connectors

Table 3-1. PM3602 Modulation Section Controls, Indicators, And Connectors (Continued)

Figure 3-1 Index No.	Control and Indicator	Reference Designation	Function
4	MOD LEVEL Control	A3R1	Provides continuously variable manual control of modulating signal.
5	SOURCE Switch, EXT, 400HZ, 1KHZ	A3S1	Selects either a 400HZ or 1KHZ internally generated modulating signal, or an externally generated EXT modulating signal.
6	OUT OF RANGE	DS1	When lit indicates a frequency out of the 10 kHz to 179.9999999 MHz range of the P360180E1 RF Section or out of range (1 MHz to 1799.9999 MHz) of the P3601.8E1 RF Section, or out of range (1 MHz to 1999.9999 MHz) of the P3602.0E1 RF Section.
7	Connector	P3	Provides interfacing of PM3602 Modulation Plug-In Section to RF Section.

3-7. OPERATING INSTRUCTIONS

3-8. Before attempting to operate the synthesizer using the internal reference oscillator, make certain the BNC jumper cable between the 10MHZ INT STD OUT and the 5/10MHZ REF IN connectors at the rear of the mainframe is in place.

3-9. LOCAL MODE. Perform steps required to make Frequency Synthesizer 360D11 or 380K11 and RF Plug-In Section P360180E1, P3601.8E1 or P3602.0E1 operational (see respective handbooks). Set modulator control as follows:

1. Set PEAK DEVIATION FULL SCALE switch so that selected modulation (peak deviation) falls within selected range.
2. Set SOURCE switch to either 400HZ, 1KHZ, or EXT, as required to achieve desired output signal. When SOURCE switch is set to EXT an external modulation signal of 1 Vrms must be applied to MOD IN jack, located on the RF Section front panel.
3. Set MODE switch to required mode of operation.
4. Adjust MOD LEVEL control to achieve required modulation input level.

3-10. REMOTE MODE. The modulation of the carrier wave may be controlled by remote programming inputs at the rear of the RF section via connector J4 at the rear of the RF Section. This 36 pin connector is the remote input for output level and modulation control. For correct remote level calibration when using an EXTERNAL modulation signal, the modulation signal must be 1.0 Vrms across 1000 Ω. Remote RF output level control is provided with the addition of RF Section Options 181 or 182.

3-11. The mating plug for J4 (not provided) is AMP Champ Plug 552284-1. The inputs are TTL compatible, positive logic[1], and each input represents one low-power load (low state sinks 0.8 mA). Input buffering (storage) is not provided, therefore, all input lines except those for the desired frequency must be held in the low state by the controller. Table 3-2 lists the pin definitions for J4.

Table 3-2. J4 Pin Designations

Pin No. ①	Function	Pin No. ①	Function
J4-1	*MPB-1	J4-19	Amplitude 1 dB
-2	MPB-2	-20	2 dB
-3	MPB-3	-21	4 dB
-4	MPB-4	-22	8 dB
-5	MPB-5	-23	10 dB
-6	MPB-6	-24	20 dB
-7	MPB-7	-25	40 dB
-8	MPB-8	-26	80 dB
-9	MPB-9	-27	+/-
-10	MPB-10	-28	Opt. Flag
-11	MPB-11	-29	Ampl. GND.
-12	MPB-12	-30	Not Used
-13	MPB-13	-31	Not Used
-14	MPB-14	-32	Not Used
-15	Not Used	-33	Not Used
-16	Modulation Option Flag ②	-34	Not Used
-17	Modulation Ground	-35	Not Used
-18	Amplitude 0.5 dB	-36	Not Used

*MPB is abbreviation for Modulation Programming Bit.

NOTE

① Connector viewed from rear.

② The Modulation Option Flag provides assurance to the controller that the appropriate modulation section is installed. With the PM3602 Modulation Section properly installed, this pin will be "low" (logical 0).

3-12. REMOTE OPERATION. To operate in the REMOTE mode:

1. Connect a source of programming information to connectors J4 and J5 on the RF Section rear panel.
2. Set LOCAL-REMOTE CONTROL to REMOTE position (360D11 only).

NOTE

Remote control of output level is available only with Options 181 or 182; remote control of modulation is available only with the PM3602 Modulation Section. In the absence of any connection at the remote input, connector J4, the unit will revert to CW operation.

① Logic LOW (0) = 0 to +0.8 volts
Logic HIGH (1) = +2.4 to +5.0 volts

3-13. MODULATION PROGRAMMING WORD. Remote modulation control is accomplished by means of a 14 bit word made up of three parts as shown in Figure 3-2.

1. Bits 11 through 14 – Modulation Mode Control
   These four bits determine the type of modulation AM, FM, ØM, the source (internal or external), and the frequency (400, 1000 Hz) of the internal source.
2. Bits 9 and 10 – Modulation Range Control
   These two bits determine the *full scale* range of modulation depth in AM, frequency deviation in FM, or phase deviation in ØM.
3. Bits 1 through 8 – Modulation Level Data Byte
   These eight bits make up a binary number which determines modulation level as a percentage of the full-scale range selected by the Range Control.

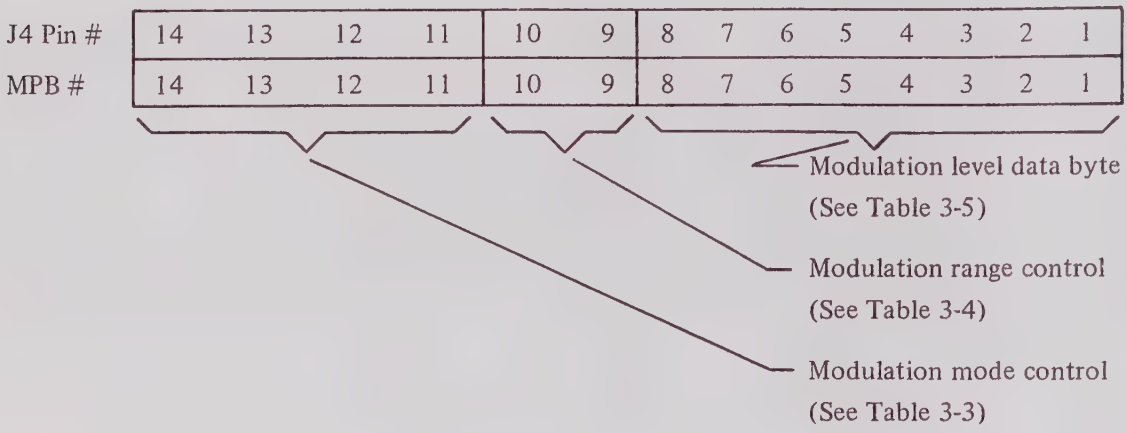

J4 Pin # 14 13 12 11 10 9 8 7 6 5 4 3 2 1
MPB # 14 13 12 11 10 9 8 7 6 5 4 3 2 1
Modulation level data byte
(See Table 3-5)
Modulation range control
(See Table 3-4)
Modulation mode control
(See Table 3-3)

Figure 3-2. Modulation Programming Word

3-14. Modulation Mode Control. MPB 11 through 14 make up the control bits that determine the type, source, and internal frequency of the modulation.

1. Bits 13 and 14 determine type of modulation as follows:

MPB 14	MPB 13	Modulation
0	0	Phase
0	1	Frequency
1	0	Amplitude
1	1	CW

2. Bits 11 and 12 select the source and the frequency of the internal source:

MPB 12	MPB 11	Modulation Source
0	0	Not Used
0	1	External
1	0	Internal 1000 Hz
1	1	Internal 400 Hz

The truth table for Modulation Mode Control is illustrated in Table 3-3.

3-15. Modulation Range Control. MPB 9 and 10 determine the ranges available for each type of modulation. These ranges are in terms of percent modulation for AM, frequency deviation for FM, and phase deviation for ØM. Table 3-4 shows the ranges available for each type of modulation, the required conditions of MPB 9 and 10 for each range, and the resolution available on each range.

Table 3-3. Modulation Mode Control Truth Table

Modulation Type		Ext. (0) / Int (1)	(1) / 400 (1) / 1000 (0)	Modulation Mode
MPB	MPB	MPB	MPB	
14	13	12	11	
0	0	0	0	Not Used
0	0	0	1	ØM-Ext.
0	0	1	0	ØM-Int. 100°
0	0	1	1	ØM-Int. 400°
0	1	0	0	Not Used
0	1	0	1	FM-Ext.
0	1	1	0	FM-Int. 1000
0	1	1	1	FM-Int. 400
1	0	0	0	Not Used
1	0	0	1	AM-Ext.
1	0	1	0	AM-Int. 1000
1	0	1	1	AM-Int. 400
1	1	0	0	Not Used
1	1	0	1	Not Used
1	1	1	0	Not Used
1	1	1	1	No Modulation (CW)

Table 3-4. Modulation Range Control

Modulation Type	MPB 10	MPB 9	Range	Resolution
AM (1, 0)	0	0	0-100%	0.5%
ØM (0, 0)	0	1	0-100°	0.5°
	1	0	0-400°	2.0°
FM (0, 1)	0	0	0-10 kHz	50 Hz
	0	1	0-100 kHz	500 Hz
	1	0	0-1 MHz	5 kHz
	1	1	0-10 MHz	50 kHz

3-16. Modulation Level Data Byte. The Modulation Level Data Byte is an eight bit binary number that expresses the desired modulation index as twice a percentage of the range selected by the Range Control.

1. For example, assume the system is set up for amplitude modulation, and the desired modulation depth is 75%. MPB 1 through 8 would then have to be:

MPB	8	7	6	5	4	3	2	1
Weight	128	64	32	16	8	4	2	1
	1	0	0	1	0	1	1	0

which is the binary number 150

2. To illustrate further, assume the requirement is for phase modulation with 180° is deviation. The Range Control would select the 400° range. 180° is then equal to 45% of full scale, and:

MPB	8	7	6	5	4	3	2	1
Weight	128	64	32	16	8	4	2	1
	0	1	0	1	1	0	1	0

which is the binary number 90.

3-17. As shown in Table 3-5, the binary number has a valid decimal range of 0 to 200 which represents 0 to 100% of the selected range. This definition provides a resolution equal to 0.5% of full scale. To determine what the binary word should be, the level desired is converted into a % of full scale, multiplied by 2, and then this decimal value is converted into a binary number. For External Modulation, full scale is defined as 1 Vrms at the modulation input jack.

Table 3-5. Modulation Level Data Byte

Bit	8	7	6	5	4	3	2	1	Decimal	% of
Weight	128	64	32	16	8	4	2	1	Value	Full Scale
	0	0	0	0	0	0	0	0	0	0
	0	1	1	0	0	1	0	0	100	50
	1	1	0	0	1	0	0	0	200	100

3-18. SUMMARY OF REMOTE OPERATION.

3-19. The modulation programming word is comprised of fourteen bits arranged in three parts:

1. *Bits 11 through 14* make up the Mode Control which determines the type, source, and internal modulation frequency.

2. *Bits 9 and 10* make up the Range Control which determines the full-scale range of modulation index for the type of modulation selected.

3. *Bits 1 through 8* make up the Level Data Byte which sets the modulation index to a resolution of 0.5% of the selected range. For correct calibration when using an EXTERNAL modulation signal the modulating signal must be 1.0 Vrms.

Two examples are provided to illustrate remote control of the PM3602 Modulation Section:

Example 1:

Internal amplitude modulation at 400 Hz, 90% modulation depth.

MPB and J4 Pin No.			
14	1		
13	0	AM	Modulation Mode Control Table 3-3
12	1	Int	
11	1	400 Hz	
10	0	100%	Modulation Range Control Table 3-4
9	0	full scale	
8	1		
7	0		
6	1	Binary	Modulation Level Control Byte Table 3-5
5	1	180	
4	0	90%	
3	1	of full scale	
2	0		
1	0		

Example 2:

External, phase modulation, 138 degree deviation.

MPB and J4 Pin No.			
14	0		
13	0	ØM	Modulation Mode Control Table 3-3
12	0	Ext	
11	1		
10	1	400°	Modulation Range Control Table 3-4
9	0	full scale	

Example 2: (Continued)

8	0		
7	1		
6	0	Binary	Modulation Level Control Byte Table 3-5
5	0	69	
4	0	34.5%	
3	1	of full scale	
2	0		
1	1		

3-20. OPERATORS MAINTENANCE.

3-21. If a PM3602 Modulation Section malfunction is suspected, perform the following checks:

1. Check that Frequency Synthesizer and RF Section are operational with PM3602 in CW mode. (Refer to appropriate RF Plug-In Section manual).
2. Check that an appropriate internal or external reference source is connected to the mainframe REF IN connector.
3. Check that P3 is properly connected and modulator section is properly installed in RF Section.
4. Check that output cable being used is not damaged or incorrectly connected. If using external modulating signal check that input cable is not damaged or incorrectly connected. If proper output is still not available, refer to Section 4.

SECTION 4

MAINTENANCE

4-1. INTRODUCTION

4-2. This section contains maintenance information for the PM3602 Modulation Section. The maintenance philosophy provides defined troubleshooting procedures to isolate a malfunction to a card or subassembly, then provides sufficient test data on each card or subassembly for further troubleshooting to a faulty component. To achieve these goals, the following are provided: the principles of operation of the Modulator, a troubleshooting chart to isolate a malfunction to a card or subassembly, and illustrations of the units. Principles of operation of each card and subassembly along with the schematic diagrams, critical test data, service block diagrams, and parts location diagrams are also provided. In addition, several critical performance tests and adjustments are given which when performed will maintain the Modulator in optimum operating condition.

4-3. PRINCIPLES OF OPERATION

4-4. The PM3602 Modulation Section (Figures 4-1 and 4-2) provides a 29 MHz signal that is either continuous wave, frequency modulated, or phase modulated, as determined by front panel controls or remote programming. The AM Modulation circuitry is in the RF Section and is controlled (switched) and monitored by the Modulation Section. Frequency and Phase modulation circuitry is in the Modulation Section assembly. The 29 MHz signal from the frequency extender is routed through the RF Section and enters the Modulator through connector P3-EE. This signal is applied to the switch combiner 1A1A1. The switch combiner acts as a multi-pole coaxial switch which connects the 29 MHz input to the selected modulator, and, also connects the selected modulator output to the 29 MHz output connector P3-AA. In the cases of CW or AM, the 29 MHz input is simply connected to the 29 MHz output ports of the switch combiner 1A1J1 and 1A1A1J4, thereby bypassing the Modulator circuits.

4-5. FREQUENCY MODULATION. In this mode, the 29 MHz signal at 1A1J1 is switched to 1A1A1J2 by the switch combiner, and is applied as a reference signal to the input port 1A2A2J5 of digital divider 1A2A2. The 29 MHz signal is divided by 8192 to a frequency of 3540 Hz and applied as a reference signal to phase detector 1A2A3. The 29 MHz oscillator 1A2A1, is an FM oscillator, and a sample signal is taken at 1A2A1E6 and also applied to the digital divider PC board, where a second identical divider is used to divide the FM signal by 8192 to 3540 Hz. This signal is also applied to the phase detector PC board 1A2A3E1 which develops an error signal proportional to the phase error between the two 3540 Hz signals. The error voltage is then applied to the 29 MHz oscillator at 1A2FL5. The phase error voltage causes the 29 MHz oscillator to be phase locked to the 29 MHz reference input signal.

4-6. The FM modulating signal is applied to the 29 MHz oscillator at 1A2J1, and causes the 29 MHz oscillator signal to deviate a maximum of 1 MHz, at rates from 20 Hz to 300 kHz. Since the sample 29 MHz is divided by 8192, the deviation is also divided similarly, and a 1 MHz deviation at 29 MHz is only

122 Hz deviation at 3540 Hz. This resultant narrow band FM signal is within the capability of the loop circuits to maintain phase lock, even when the 29 MHz oscillator is fully modulated.

4-7. The frequency modulated 29 MHz signal is taken from the 29 MHz oscillator at 1A2J3 and applied to the switch combiner at 1A1A1J3, where in the FM mode it is switched to the 29 MHz output cable at 1A1A1J4. The frequency modulated 29 MHz output signal routed back to the frequency extender causes the frequency synthesizer RF output to be similarly modulated.

4-8. PHASE MODULATION. In this mode, the 29 MHz input signal at 1A1J1 is switched to the phase modulator at 1A1A2E3 by the switch combiner. The phase modulated signal at the modulator output 1A1A2E3 is applied to the switch combiner and switched to the 29 MHz output port 1A1A1J4. The modulating signal is routed through the 1A2 housing and applied to the phase modulator at 1A1A2J5. The phase modulator acts as a voltage variable delay line which advances or retards the phase in accordance with the modulating signal. The phase modulated 29 MHz output signal routed back to the frequency extender causes the frequency synthesizer RF output to be similarly modulated.

4-9. 1A4 LOGIC CONTROL

This control board performs the following functions:

1. Receives MODE logic from either the front panel MODE switch 1A3S3, or the remote logic, and develops two logic signals which control the switch combiner. The two logic signals are FM/ØM select which is applied to 1A1FL3 and FM, ØM, ON/OFF applied to 1A1FL1.
2. Receives band logic information on 1A4J4-5, 6, 20 from the logic converter of the RF plug-in and sets a band attenuator which attenuates the input FM or ØM modulating signal to compensate for the RF multiplication factor. Table 4-1 lists the frequency ranges, logic signals, RF multiplication factor, and required attenuation.
3. Receives Range logic on 1A4J4-3, and 1A4J7-8, 9 from the Peak Deviation switch 1A3S2 and remote logic, and sets the Range Attenuator located on the 1A4 logic control PC board to the proper attenuation for the four FM ranges and the two ØM ranges.
4. Receives Remote Level Control logic on J4-1 to 8, and sets a level control attenuator for remote programming of AM, FM, and ØM modulation indices. For correct calibration in the Remote Mode the modulating signal level to the front panel modulation input must be 1.0 Vrms. The fixed amplitude modulation signal is applied to the Remote level attenuator in the logic control board at 1A4J1. The variable amplitude modulating signal for Local level control from the MOD LEVEL control 1A3R1 is applied to 1A4J2. This signal bypasses the remote attenuator.
5. Provides the detector and amplifier circuits for the Modulation Meter.
6. Routes the AM modulating signal when in AM mode from J4-15 to the AM modulator in the RF Section.

Table 4-1. RF Multiplication Factors

Band*	RF Frequency Range: 180 MHz and 1.8 GHz RF Sections	RF Frequency Range: 2 GHz RF Section	J4 Band Logic 4	2	1	RF Multiplication Factor	Band Attenuation Factor
1	.01 to <60	**.01 to <60	0	0	1	1	1:1
1A	60 to <180		0	0	0	2	2:1
2	60 to <80	60 to <100	0	1	0	1.25	1.25:1
3	80 to <160	100 to <200	0	1	1	2.5	2.5:1
4	160 to <320	200 to <400	1	0	0	5	5:1
5	320 to <900	400 to <1000	1	0	1	10	10:1
6	900 to <1800	1000 to <2000	1	1	0	20	20:1

*Bands 1 and 1A for 180 MHz Plug-In.
Bands 1, 2, 3, 4, 5, 6 for 1800 MHz Plug-In and 2000 MHz Plug-In.
**Used Only for 2000 MHz Plug-In.

7. Routes the amplitude controlled FM, and ØM modulating signals to the frequency and phase modulators from 1A4J3.

8. Provides switched 5 Vdc power at 1A4J6-2 which turns off the 29 MHz oscillator when not in the FM mode.

9. Provides switches –12 Vdc power at 1A4J5-10 which turns off the 400/1000 Hz modulation oscillator when the SOURCE switch is in EXT.

10. Receives the LOC/REM logic signal at 1A4J4-25 to set programming control of the Modulator.

"0" = Local
"1" = Remote

11. Receives the *Out Of Range* logic signal on 1A4J4-16 and applies it to the OUT OF RANGE indicator DS1.

4-10. Modulation oscillator 1A1A3, controlled by logic signals from the 1A4 logic control, furnishes low distortion sine wave output at 400 Hz or 1000 Hz when modulating with the 1A3S1 SOURCE switch in either the 400 or 1000 Hz positions. The switched fixed amplitude (1.0 Vrms) 400 or 1000 Hz signal outputs at 1A1J7 and is applied to the front panel MOD LEVEL control 1A3R1.

4-11. TROUBLESHOOTING

4-12. Figure 4-3 is a diagnostic troubleshooting chart for the Modulator Section. Through use of the chart, interconnection diagram Figure 4-2, and the servicing block diagram Figure 4-1, a malfunction can be isolated to a PC board or subassembly. Figure 4-4 shows the location of all assemblies in the unit; to further

isolate a malfunction to a defective component on a PC board or subassembly, refer to the applicable paragraph on repair of the PC board or subassembly.

4-13. REPAIR

4-14. The following paragraphs provide repair data for each PC board and subassembly of the Modulation Section. The data is presented in the form of functional descriptions with the significant circuit parameters, schematic diagrams, and parts location diagrams. With this data, it is possible to isolate a malfunction to a component on a subassembly when the subassembly is either in the unit or on a bench using simulated input signals.

4-15. Repair Data for each printed circuit board can be found on the diagnostic troubleshooting chart (Figure 4-3), the referenced schematic diagrams, and in the functional descriptions. To facilitate identification of parts, component location diagrams are included for each printed circuit card. Refer to Section 5 for the Replaceable Parts List.

4-16. MODULATION CONTROL 1A1 Figure 4-5

4-17. SWITCH COMBINER 1A1A1. The switch combiner PC board 1A1A1 (Figure 4-6) is mounted in the 1A1 housing and contains four dpdt relays to provide the RF switching. Two logic signals at E3 and E5 provide the control to relay driver transistors Q1, Q2, Q3, Q4. In the AM or CW modes, control line E3 (FM, ØM, ON/OFF) is low, and relays K1 and K3 remain deenergized. The 29 MHz signal at J1 then exits at J4, the 29 MHz output.

4-18. In the FM or ØM modes, control line E3 is high, thereby turning on relay drivers Q1 and Q3, and energizing relays K1 and K3. The 29 MHz signal at J1 now appears at relay K2-8. This relay directs the 29 MHz signal to the FM port at J2, when deenergized, and the 29 MHz signal at J3 is switched to the 29 MHz output port J4 through K3. In the ØM modes, the 29 MHz ØM signal at E4 is switched to port J4 through K3. Relays K2 and K4 are energized when the FM, ØM, select line at E5 goes high.

4-19. PHASE MODULATOR 1A1A2. The phase modulator PC board 1A1A2 (Figure 4-7) circuit consists of amplifier Q1 and Q2 and associated circuitry, and a differential amplifier comprised of Q3 and Q4. When in the phase modulation mode, the modulation signal is received at J5, either from an external modulation source or the internal oscillator.

4-20. The 29 MHz input signal is applied to through terminal E3 to a voltage variable bridged-tee modulator circuit consisting of R2, R3, CR1, L1, L3, and C2. The phase modulated output of the bridge circuit is amplified in Q1 and applied to a similar bridged tee and further amplified by Q2. This section consisting of L10, L12, C11, and C13 attenuates harmonics of 29 MHz. LIN adj potentiometers R3 and R9 provide adjustment of phase linearity.

4-21. The phase modulating signal is received at J5 and then applied to differential amplifier Q3 and Q4. The modulation sensitivity is set by ØM SEN adj potentiometer R22, and VAR BIAS adj potentiometer R18 which adjusts the bias voltage for best linearity. The output of the differential amplifier is applied to emitter follower Q5 which reduces the output impedance and drives the reactive modulator load. This signal is applied to varactor diodes CR1 and CR2, thereby controlling the phase delay through both networks.

4-22. MODULATION OSCILLATOR 1A1A3. This modulation oscillator PC board 1A1A3 (Figure 4-8) consists of a switched bridged-tee network in a negative feedback loop around amplifier U1 which controls frequency. There are also two positive feedback loops, one through diode CR6 for automatic gain control.

4-23. Relay K2 driven directly from U2-7 switches the components for 400 Hz or 1000 Hz operation; potentiometers 400HZ adj R4 and 1KHZ adj R5 control the frequencies. Relay K1 switches between the modulation oscillator output at C9, and the EXT MOD signal at E10, and furnishes either of the two signals to the MOD LEVEL control at the board output E11. The relays are driven directly from U2, a quad-2 input multiplexer. The inputs to U2 are bits 11 and 12 of the modulation programming word, from both the front panel MODE switch, or a remote controller. The LOC/REM logic signal at E3 controls the multiplexer. The multiplexed bit 12 appears at U2-4, and is the INT/EXT logic signal which is applied to logic converter 1A4. Refer to Table 4-2 for the U2 multiplexer truth table.

Table 4-2. Multiplexer 1A1A3U2 Truth Table

U2 Pinouts	Local Control Function			Remote Control Function		
	EXT	INT 400	INT 1000	EXT	INT 400	INT 1000
1	0	0	0	1	1	1
2	0	1	0	X	X	X
3	X	X	X	0	1	1
4	0	1	1	0	1	1
5	1	1	1	X	X	X
6	X	X	X	1	1	0
7	X	1	0	X	1	0

0: ≤0.8 volts 1: ≥2.4 volts X: = Don't Care

LEVEL Adj potentiometer 1A1A3R13 is set to provide a 1.0 Vrms signal to the MOD LEVEL control.

4-24. PHASE LOCK LOOP 1A2 Figure 4-9

4-25. 29 MHz OSCILLATOR 1A2A1. (Figure 4-10) Transistors Q2 and Q3 form a differential amplifier circuit with one input (Q2 base) receiving the FM modulating signal from 1A2A1U1. The phase error signal is applied to the second input and both signals are then summed. The resulting output signal is applied to a 290 MHz oscillator (Vco) Q4 and CR1. The oscillator output signal is applied to divide-by-ten circuit U1 via buffer driver Q1. U1 provides an output at E6 which is applied unfiltered to the divider PC board 1A2A2. U1 also provides a second output at J3 which is filtered to attenuate harmonics and applied to 1A2J3. When not in the FM mode, the 5V FM line is low, which turns off Q5, thereby removing -12 Vdc from the oscillator Q4.

4-26. DIVIDER 1A2A2. (Figure 4-11) The divider PC board contains two divider chains, U1, U2 and U3, U4, each divide by 8192. The 29 MHz REF IN at J5 is divided to 3540 Hz and applied to the emitter

follower circuit Q3 which drives one input of the phase detector circuit. The 29 MHz oscillator signal from E1 is routed to buffer driver Q2 via a filter network comprised of C4, L1, L2 and C6. This filter prevents 3540 Hz and its harmonics from feeding back to the voltage controlled oscillator and appearing on the output. The output of this chain also at 3540 Hz drives the second input of the phase detector.

4-27. PHASE DETECTOR 1A2A3. (Figure 4-12) The phase detector circuit consists of balanced modulator U1, loop filter network (R5 through R10 and R18, C9 through C12, C14 and C15) and operational amplifier U2. Two input signals, each of 3540 Hz, are received at E1 and E2 respectively and are routed to balanced modulator U1. The resultant phase error signal at U1-3 and 13 is then routed through the loop filter network which attenuates the 3540 Hz signal. Operational amplifier U2 sets the loop gain via GAIN Adj potentiometer R13. The resultant output signal at U2-7 is further filtered by resistor R18 and capacitor C14.

4-28. BEZEL ASSEMBLY 1A3

4-29. Bezel assembly 1A3 (Figure 4-13) provides the front panel mounting for the S3 MODE switch, the S2 PEAK DEVIATION FULL SCALE switch, the S1 SOURCE switch, the R1 MOD LEVEL control, the modulation meter, and the OUT OF RANGE indicator DS1.

4-30. LOGIC CONTROL 1A4 (Figure 4-14)

4-31. LOC/REM CONTROL. Range and Mode control logic from either the front panel switches or a remote controller are received at J4-1, 2, 3, 14 and J7-4, 5, 8, 9 and the LOC/REM logic at J4-25, and applied to multiplexer U2. The logic truth table for U2 is shown in Tables 4-3 and 4-4. The multiplexed output from U2 drives the range/mode decoder PROM U4. U2 also provides the FM, ØM, ON/OFF logic signal at pin 12, and the FM/ØM select signal at pin 9.

4-32. RANGE/MODE DECODER. Range logic is applied to pins 12, 13 of the range/mode decoder U4. Mode control logic is applied to pins 10 and 11. The INT/EXT logic from the 1A1A3 modulation oscillator is applied to pin 14. U4 decodes this logic according to Table 4-5 and drives range attenuator relays K1, K2, K3, and K4. It also provides relay drive for K5, K6, and K8. K5 removes 5V power to the 29 MHz FM oscillator when not in the FM mode. K6 removes -12V power to the 1A1A3 modulation oscillator when not in the INT 400 Hz or INT 1000 Hz mode.

4-33. U4 also provides a 10 MHz range logic signal at U4-1 to band attenuator decoder U1. Range attenuation for the peak deviation scales 10KHZ, 100KHZ, 1MHZ, 10MHZ, 100°, and 400° are controlled by the relay-switched ladder attenuator consisting of relays K1, K2, K3, and K4, and precision resistors R7, R8, R9 and R21. The range attenuator relays are driven directly from the range/mode decoder U4, and provides the required attenuation of the FM and ØM modulating signal for each range. These relays are energized when the logic lines are low, according to the truth Table 4-5. U11 is an operational amplifier connected as a follower to provide a high impedance load to the attenuator. R38 and C15 are an amplitude correction network. For FM stereo multiplex, R38 can be adjusted for best L-R channel separation.

Table 4-3. 1A4U2 Truth Table Local Mode

Modulation Mode	1A4U2 Pinouts												
	Inputs									Outputs			
	1	2	3	5	6	10	11	13	14	4	7	9	12
EXT/PM/100°	0	1	X	0	X	X	0	X	0	0	X	0	0
EXT/FM/10 kHz	0	0	X	0	X	X	1	X	0	0	0	1	0
EXT/AM	0	X	X	X	X	X	0	X	1	X	X	0	1
CW	0	0	X	0	X	X	1	X	1	X	X	1	1
EXT/FM/100 kHz	0	1	X	0	X	X	1	X	0	1	0	1	0
EXT/FM/400°	0	0	X	1	X	X	0	X	0	X	1	0	0
EXT/FM/1 MHz	0	0	X	1	X	X	1	X	0	0	1	1	0
EXT/FM/10 MHz	0	1	X	1	X	X	1	X	0	1	1	1	0
INT/PM/100°	0	1	X	0	X	X	0	X	0	X	0	0	0
INT/FM/10 kHz	0	0	X	0	X	X	1	X	0	X	X	1	0
INT/AM	0	X	X	X	X	X	0	X	1	0	0	0	1
INT/FM/100 kHz	0	1	X	0	X	X	1	X	0	1	0	1	0
INT/PM/400°	0	0	X	1	X	X	0	X	0	X	1	0	0
INT/FM/1 MHz	0	0	X	1	X	X	1	X	0	0	1	1	0
INT/FM/10 MHz	0	1	X	1	X	X	1	X	0	1	1	1	0

X = Don't Care

Table 4-4. 1A4U2 Truth Table Remote Mode

Modulation Mode	1A4U2 Pinouts												
	Inputs									Outputs			
	1	2	3	5	6	10	11	13	14	4	7	9	12
EXT/PM/100°	1	X	1	X	0	0	X	0	X	0	X	0	0
EXT/FM/10 kHz	1	X	0	X	0	1	X	0	X	0	0	1	0
EXT/AM	1	X	X	X	X	0	X	1	X	X	X	0	1
CW	1	X	0	X	0	1	X	1	X	X	X	1	1
EXT/FM/100 kHz	1	X	1	X	0	1	X	0	X	1	0	1	0

Table 4-4. 1A4U2 Truth Table Remote Mode (Continued)

Modulation Mode	1A4U2 Pinouts												
	Inputs									Outputs			
	1	2	3	5	6	10	11	13	14	4	7	9	12
EXT/PM/400°	1	X	0	X	1	0	X	0	X	X	1	0	0
EXT/FM/1 MHz	1	X	0	X	1	1	X	0	X	0	1	1	0
EXT/FM/10 MHz	1	X	1	X	1	1	X	0	X	1	1	1	0
INT/PM/100°	1	X	1	X	0	0	X	0	X	X	0	0	0
INT/FM/10 kHz	1	X	0	X	0	1	X	0	X	X	X	1	0
INT/AM	1	X	X	X	X	0	X	1	X	0	0	0	1
INT/FM/100 kHz	1	X	1	X	0	1	X	0	X	1	0	1	0
INT/PM/400°	1	X	0	X	1	0	X	0	X	X	1	0	0
INT/FM/1 MHz	1	X	0	X	1	1	X	0	X	0	1	1	0
INT/FM/10 MHz	1	X	1	X	1	1	X	0	X	1	1	1	0

X = Don't Care

Table 4-5. Range/Mode Decoder 1A4U4 Truth Table

Modulation Mode	1A4U2 Pinouts												
	Inputs					Outputs							
	14	13	12	11	10	8	7	6	5	4	3	2	1
EXT/PM/100°	0	0	X	0	0	1	1	0	1	1	1	1	1
EXT/FM/10 kHz	0	0	0	0	1	1	1	1	0	0	1	1	1
EXT/AM/100%	0	X	X	1	0	1	0	1	1	1	1	1	1
CW	X	X	X	1	1	1	1	1	1	1	1	1	1
EXT/AM/100 kHz	0	0	1	0	1	1	1	1	0	1	0	1	1
EXT/PM/400°	0	1	X	0	0	1	1	1	1	1	1	0	1
EXT/FM/1 MHz	0	1	0	0	1	1	1	1	0	1	1	0	1
EXT/FM/10 MHz	0	1	1	0	1	1	1	1	0	1	1	1	0
EXT/PM/100°	0	0	X	0	0	1	1	0	1	1	1	1	1
EXT/FM/10 kHz	0	0	0	0	1	1	1	1	0	0	1	1	1
EXT/AM/100%	0	X	X	1	0	1	0	1	1	1	1	1	1
CW	X	X	X	1	1	1	1	1	1	1	1	1	1

Table 4-5. Range/Mode Decoder 1A4U4 Truth Table (Continued)

Modulation Mode	1A4U4 Pinouts												
	Inputs					Outputs							
	14	13	12	11	10	8	7	6	5	4	3	2	1
EXT/AM/100 kHz	0	0	1	0	1	1	1	1	0	1	0	1	1
EXT/PM/400°	0	1	X	0	0	1	1	1	1	1	1	0	1
EXT/FM/1 MHz	0	1	0	0	1	1	1	1	0	1	1	0	1
EXT/FM/10 MHz	0	1	1	0	1	1	1	1	0	1	1	1	0
INT/PM/100°	1	0	X	0	0	0	1	0	1	1	1	1	1
INT/FM/10 kHz	1	X	X	0	1	0	1	1	0	0	1	1	1
INT/AM/100%	1	0	0	1	0	0	0	1	1	1	1	1	1
INT/FM/100 kHz	1	0	1	0	1	0	1	1	0	1	0	1	1
INT/PM/400°	1	1	X	0	0	0	1	1	1	1	1	0	1
INT/FM/1 MHz	1	1	0	0	1	0	1	1	0	1	1	0	1
INT/FM/10 MHz	1	1	1	0	1	0	1	1	0	1	1	1	0

X = Don't Care

4-34. BAND ATTENUATOR. This circuit consists of band decoder PROM U1, a multiplying DAC, U3, and an operational amplifier, U5. The circuit attenuates the FM, ØM modulating signal from K7 in accordance with the RF multiplication factor as shown in Table 4-1. Band logic information from the RF Plug-In logic controller is received at J4-5, 20, and applied to the band decoder PROM U1. 10 MHz range from U4 is also applied to U1-13, which decodes this logic as shown in Table 4-6. The 10 MHz FM range is not allowed in Bands 1-4. In these bands, U1-13 is held low and the attenuator output is zero. In Band 5, when the 10 MHz range is selected, U1-13 is low, and the attenuator output is maximum, or 10 times the value of the output when U1-13 is high. Band 1 CAL Adj potentiometer 1A4R6 is adjusted to provide 1.0 ± 0.01 Vrms modulating signal at J3, when in Band 1 with the PEAK DEVIATION set to 100KHZ in the INT source mode.

4-35. REMOTE LEVEL CONTROL. A multiplying DAC U6, and operational amplifier U7, provide the programmable attenuator remote level control. The modulating signal for AM, FM, or ØM is received at J1 and applied to the attenuator input U6-15. For correct full scale calibration on any range, this voltage must be 1.0 Vrms. Programming logic is received in binary format at J4 and applied to the logic input of U6. The attenuator output is taken at U7-10 and applied to the normally closed contact of K7. In remote mode, the LOC/REM logic line is high, and K7 is deenergized. The remote controlled modulating signal is taken from K7 and applied to the band attenuator at U3-15.

Table 4-6. Band Decoder 1A4U1 and Operational Amplifier U5 Output Truth Table

Band	RF Freq.	1A4U1 Pinouts												U5 Output**
		Inputs				Outputs								
		10	11	12	13*	1	2	3	4	5	6	7	9	Pin 10 Volts RMS
1	0.01 to 60	1	0	0	1	1	0	0	1	1	0	0	0	1.00 ± 0.01
1A	60 to 180	0	0	0	1	0	0	1	1	0	1	0	0	0.500 ± 0.01
2	60 to 80	0	1	0	1	0	0	1	0	1	0	0	0	0.800 ± 0.01
3	80 to 160	1	1	0	1	0	1	0	1	0	0	0	0	0.400 ± 0.007
4	160 to 320	0	0	1	1	1	0	1	0	0	0	0	0	0.200 ± 0.005
5	320 to 900	1	0	1	1	0	1	0	0	0	1	0	0	0.100 ± 0.002
6	900 to 1800	0	1	1	1	1	0	0	0	0	0	1	0	0.050 ± 0.001
1	0.01 to 60	1	0	0	0	0	0	0	0	0	0	0	0	0
1A	60 to 180	0	0	0	0	0	0	0	0	0	0	0	0	0
2	60 to 80	0	1	0	0	0	0	0	0	0	0	0	0	0
3	80 to 160	1	1	0	0	0	0	0	0	0	0	0	0	0
4	160 to 320	0	0	1	0	0	0	0	0	0	0	0	0	0
5	320 to 900	1	0	1	0	1	0	0	1	1	0	0	0	1.00 ± 0.01
6	900 to 1800	0	1	1	0	0	0	1	1	0	1	0	0	0.5 ± 0.01

*U1-13 is low in the 10 MHz peak deviation range, and high in other ranges.

**SOURCE CONTROL set to INT 400 or 1000, MODE switch to FM or ØM. U5 output is set by adjusting BAND 1 CAL Adj potentiometer 1A4R6 in Band 1 to 1.00 ± 0.01 Vrms.

4-36. In the local mode, the LOC/REM line is low and K7 is energized. In this case, the modulating signal from the wiper of the MOD LEVEL control is selected by K7 and applied to the band attenuator.

4-37. REM CAL ADJ potentiometer R35 is a level adjust, and R35 is adjusted by programming the modulation level byte to the full scale number 200 in binary format as shown in Table 3-5. In the Internal Source Mode, R35 is set for 1.0V ± 0.01 Vrms output at U7-10.

4-38. METER AMPLIFIER. The modulating signal at the arm of relay K7, which is applied to the band attenuator U3, is also applied to the meter amplifier circuit consisting of U9, U10, U12, and U13. The circuit must respond to the peak positive and negative values of the modulating signal, since the AM and ØM modulators are dc coupled. The meter amplifier also responds to the absolute value of the dc voltage.

4-39. The modulating signal is applied to the meter amplifier through a frequency compensating network consisting of C10, R11, and R31. Two peak detecting circuits are used, U9 and U12 for positive detection, and U10 and U13 for negative detection. The circuits are identical except for the reversed polarities of the

detector diodes CR8, and CR11. Referring to the U9 circuit, a positive voltage at input U9-5 is amplified and the positive output forward biases CR8, allowing C4 to charge. The positive swing at the output of U9 occurs when the input signal rises above the level of the signal fed back through R17. This feedback signal equals the output level, and the capacitor charges until the output level reaches the input level peak. When the input signal decreases, C4 discharges to the lower value peak through R24. This positive peak detected voltage is amplified by non inverting amplifier U12, and applied through isolation diode CR10 and meter multiplier R29 and METER CAL ADJ potentiometer R30, to the modulation meter.

4-40. The U10 circuit is similar to U9 except that negative peaks are detected by CR11, and amplifier U13 is connected as an inverting amplifier. Thus a negative dc voltage is inverted by U13 and the positive output is connected to the meter through CR13 and multiplier resistors R29 and R30. Diodes CR9 and CR12 prevent the amplifier inputs from incorrect polarity voltages.

4-41. CALIBRATION

1. The following calibration procedures apply to the PM3602 Modulation Section when used in conjunction with a 360D11 Mainframe. Refer to paragraph 5-21 in the 380K11 Mainframe manual when the PM3602 Modulation Section is used with the 380K11 Mainframe.
2. Refer to Table 4-7 for a complete listing of adjustable components and their location and function.

Table 4-7. Adjustable Components

Adjustment	Reference Designation	Paragraph	Figure No.	Function
LIN Adj	1A1A2R3	4-54	4-5	Adjustment for phase modulation linearity
LIN Adj	1A1A2R9	4-54	4-5	
VAR BIAS Adj	1A1A2R18	4-54	4-5	Adjustment for ØM depth of null
ØM SEN Adj	1A1A2R22	4-54	4-7	Calibrates ØM deviation
400 HZ Adj	1A1A3R4	4-43	4-8	Internal 400 Hz freq adjustment
1KHZ Adj	1A1A3R5	4-43	4-8	Internal 1 kHz freq adjustment
LEVEL ADJ	1A1A3R13	4-43	4-8	Internal Osc level adjustment
29MHZ Adj	1A2A1C9	4-47	4-10	Frequency Adjustment for FM oscillator
FM SEN Adj	1A2A1R10	4-49	4-10	Calibrates FM deviation
GAIN Adj	1A2A3R13	4-47	4-12	Adjustment of FM phase lock loop gain

Table 4-7. Adjustable Components (Continued)

Adjustment	Reference Designation	Paragraph	Figure No.	Function
BAND 1 CAL ADJ	1A4R6	4-45, 4-52	4-14	Band Attenuator gain adjustment
METER CAL ADJ	1A4R30	4-45	4-14	Calibrates Modulation Meter
REM CAL ADJ	1A4R35	4-57	4-14	Remote level attenuator gain adjustment
FM STEREO SEPARATION ADJ	1A4R38	4-45, 4-52	4-14	Adjustment to maximize Stereo separation

4-42. MODULATION OSCILLATOR 1A1A3.

Test Equipment Required

Cable Assembly	AILTECH 299543-3
Digital Voltmeter	Systron Donner 7004
Extender Cable	AILTECH 299820
Frequency Counter	Dana 7720

4-43. Procedure:

1. Remove PM3602 Modulator and connect to 360 with extender cable.
2. Disconnect coaxial connectors and power connector of 1A2 assembly. Remove (3) three screws securing 1A2 assembly and swing assembly aside.
3. Set modulation section MODE switch to AM, and the SOURCE switch to 400HZ.
4. Connect frequency counter to 1A1A3J7 and adjust 400HZ potentiometer 1A1A3R4 for a counter reading of 400 Hz ± 4 Hz.
5. Set the modulator SOURCE switch to 1KHZ.
6. Adjust 1KHZ potentiometer 1A1A3R5 for a frequency counter reading of 1000 ± 10 Hz. Reconnect internal cable to 1A1A3J7.
7. Connect digital voltmeter to pin 15 of 1A4U3. Set DVM for ac, 10 Vrms scale. Adjust LEVEL ADJ potentiometer 1A1A3R13 for a voltmeter reading of 1.00 Vrms ± 0.01V.
8. Check that modulation oscillator shuts off with SOURCE switch to EXT. Also with the MODE switch to CW and the SOURCE switch to 400HZ or 1KHZ.
9. Reconnect 1A2 Assembly.

4-44. MODULATION METER CALIBRATION.

Test Equipment Required

Digital Voltmeter	Systron Donner 7004

4-45. Procedure:

NOTE

Meter calibration can be performed with PM3602 modulator in place by removing the top cover of the synthesizer.

1. Set the Modulation Section MODE switch to AM, and the SOURCE switch to 400HZ.
2. Connect DVM to pin 15 of 1A4U3 and set DVM for ac, 10 Vrms scale.
3. Set MOD LEVEL control (front panel) for a DVM reading of 0.07 Vrms ± 0.01V.
4. Adjust METER CAL ADJ potentiometer 1A4R30 for an indication of 70 on the modulation meter.
5. Set FM STEREO SEPARATION ADJ potentiometer 1A4R38 to a nominal value of 200 ohms or follow the Stereo Separation Adjustment paragraph 4-50.
6. Set the synthesizer to 50 MHz, FM mode, and 1 MHz peak deviation.
7. Connect a DVM to 1A4J3 and set BAND 1 CAL ADJ potentiometer 1A4R6 for a reading of 0.07 Vrms ± .01V.

4-46. FM PHASE LOCK LOOP ADJUSTMENT.

Test Equipment Required

Adapter BNC Female to SMB Plug	AILTECH 294677
Adapter SMB Tee	AILTECH 294678
Cable Assembly	AILTECH 299453-3
Digital Voltmeter	Systron Donner 7004
Frequency Counter	Dana 7720
Insulated board to protect modulator	

4-47. Procedure:

1. Remove top cover from 360. Remove PM3602 Modulator, place on top of 360 or 380, and reconnect modulation section connector. Support modulator with an insulated board. Do not use extender cable.

2. Set Modulator MODE switch to FM, SOURCE switch to EXT, PEAK DEVIATION to 10KHZ, and MOD LEVEL fully counterclockwise.
3. Remove coax cables from connectors 1A2J3 and 1A2J5 and connect cables together using the tee adapter, 294678.
4. Connect frequency counter to connector 1A2J3, and adjust 29 MHz tuning capacitor 1A2A1C9 for a counter reading of 29 MHz ± 5 kHz. Disconnect counter.
5. Connect synthesizer RF output to connector 1A2J5. Set for 0 dBm at 29.000 MHz.
6. Connect the DVM to test point 1A2A3TP1 and set for the 1.0 Vdc range. Record voltage to within 0.1 mV. (Voltage will be about 0 volts ± 50 mV).
7. Change frequency to 29.1 MHz and record new voltage at test point TP1. The difference between the voltage readings at 29.9 MHz and 29.1 MHz should be 12.5 mV ± 1.0 mV. Adjust GAIN Adj potentiometer 1A2A3R13 in small increments until this voltage difference is within the tolerance.
8. Connect frequency counter to connector 1A2J3. Set synthesizer for 28.0 MHz and increase frequency in 100 kHz steps until counter reading is the same as the synthesizer frequency, indicating phase lock. Record this frequency. It should be less than 28.7 MHz.
9. Set synthesizer for 29.9 MHz and lower the frequency in 100 kHz steps until the counter indicates phase lock, as above. This frequency should be greater than 29.3 MHz.
10. If the requirements of steps 8 and 9 are not achieved repeat steps 4 through 7.
11. Reconnect all modulator cables.

4-48. FM CALIBRATION.

Test Equipment Required

Frequency Counter	Dana 7720
Function Generator	Wavetek 142
Spectrum Analyzer	AILTECH 757

4-49. Procedure:

1. Remove top cover from 360. Remove PM3602 Modulator, place on top of 360 and reconnect modulation section connector.
2. Set Modulation Section MODE switch to FM, SOURCE switch to EXT, and PEAK DEVIATION FULL SCALE switch to 100KHZ. Set synthesizer output frequency to 100.00 MHz.
3. Adjust function generator for a sine wave output at 29.14 kHz using the frequency counter, and a level between 1.2 and 1.5 Vrms. Connect this signal to MOD IN connector.

4. Connect spectrum analyzer to synthesizer output. Set analyzer scan width to 30 kHz/cm and adjust Modulation Section MOD LEVEL control for a deviation reading of 70 kHz on the meter.

5. Adjust FM SEN potentiometer 1A2A1R10 for the first carrier null.

4-50. STEREO SEPARATION ADJUSTMENT.

4-51. This adjustment can be used to optimize stereo separation when the synthesizer is modulated with an FM Stereo Multiplex signal. FM STEREO SEPARATION ADJ potentiometer 1A4R38 is located on control PC board 1A4. The control is set at the factory for a nominal resistance of 200 ohms.

4-52. Procedure:

1. Unfasten the PM3602 Modulator front panel screws, and the modulator rear bracket screw, and slide the modulation forward slightly to allow access to potentiometer 1A4R38.

2. Connect an FM stereo multiplex signal to the MOD IN connector, and set controls for FM, 100 kHz peak deviation.

3. Connect synthesizer to an FM deviation meter with a stereo decoder. Follow normal procedure for measuring separation. If separation is less than 40 dB, adjust R38 for best separation, 40 to 48 dB.

4. Adjustment of R38 will somewhat affect the FM calibration. Repeat steps 3 and 4 of paragraph 4-49.

5. Adjust BAND 1 CAL ADJ potentiometer 1A4R6 for the first carrier null.

Alternate – If desired to recalibrate using the FM deviation meter instead of the above procedure, simply adjust 1A4R6 for an FM deviation meter reading corresponding to the PM3602 meter reading.

4-53. PHASE MODULATION CALIBRATION.

Test Equipment Required

Digital Voltmeter	Systron Donner 7004
Extender Cable	AILTECH 299820
Function Generator	Wavetek 142
Spectrum Analyzer	AILTECH 757

4-54. Procedure:

1. Remove PM3602 Modulator and connect to 360 with extender cable.

2. Set Modulator MODE switch to ØM. Set SOURCE switch to EXT, and set PEAK DEVIATION FULL SCALE control to 400°. Set synthesizer frequency to 100 MHz.

3. Connect voltmeter to test point 1A1A2TP1 and adjust VAR BIAS Adj potentiometer 1A1A2R18 for a reading of 2.5 to 3.0 Vdc.

4. Set function generator to approximately 20 kHz and connect to MOD IN connector, using a 50 ohm load. Connect spectrum analyzer to the synthesizer output, and set for a scan width of 30 kHz/cm.
5. Adjust function generator output level for the first carrier null. Adjust the function generator dc offset in conjunction with the output level, to obtain the lowest carrier null.
6. Switch off the dc offset on the function generator or use a dc block at the MOD input and re-adjust 1A1A2R18 for the lowest null depth as in step 5.
7. Adjust linearity potentiometers 1A1A2R3 and R9 to increase the depth of the null.
8. Set the synthesizer frequency to 50.0 MHz. Do not change the spectrum analyzer settings, thereby observing the second harmonic at 100 MHz. Set the PEAK DEVIATION FULL SCALE control to 100°. Adjust the MOD LEVEL switch for a reading of 70°. Adjust ØM SEN Adj potentiometer 1A1A2R22 for the first carrier null.

There are no calibration adjustments for AM in the PM3602 modulator. The adjustment procedure is located in the manuals for the RF Sections, PM360180E1, PM3601.8E1, or PM3602.0E1.

4-55. REMOTE MODULATION LEVEL CONTROL CALIBRATION, FM AND ØM.

4-56. This calibration only affects operation in the REMOTE programming mode. The following adjustments calibrate the FM and ØM modes of modulation. The procedures of paragraphs 4-44 and 4-48 must be performed prior to this calibration.

Test Equipment Required

Digital Voltmeter	Systron Donner 7004
Frequency Counter	Dana 7720
Function Generator	Wavetek 142
Remote Controller	
Spectrum Analyzer	AILTECH 757

4-57. Procedure:

1. Connect the controller to the J4 and J5 connectors at the rear of the synthesizer.
2. Connect the function generator to the MOD IN connector, and set the function generator to 20.45 kHz using the frequency counter, and set the level to 1.0 Vrms using the DVM.
3. Set the LOC/REM switch to Remote. Set the controller to program a frequency of 100 MHz. Set the controller for 0 dBm (181 or 182 option only), Frequency Modulation, External 100 kHz Range. Set the level data byte for 40 kHz deviation. These modulator instructions are accomplished when the modulation data byte into the J4 connector is set as shown.

J4 Pin #	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Logic Level	0	1	0	1	0	1	0	1	1	0	0	1	0	0

4. Connect the RF output to the spectrum analyzer and remove top cover from synthesizer. Adjust analyzer to display the 100 MHz signal, and set scan width to 30 kHz/cm.

5. Adjust REM CAL ADJ potentiometer 1A4R35 on the control board for the first carrier null.

4-58. AMPLITUDE MODULATION CALIBRATION

4-59. The adjustment procedures for amplitude modulation must be performed in the following sequence.

Procedure:

1. Perform the Modulation Meter Calibration as indicated in paragraph 4-44.

2. Perform the Remote Modulation Level Control Calibration FM and ØM as indicated in paragraph 4-55.

3. Output Level and Modulation Linearity Calibration, refer to paragraph 4-108 of P360180E1 manual, paragraph 4-115 of P3601.8E1 manual or paragraph 4-87 of P3602.0E1 manual.

4. Perform the Modulation Sensitivity adjustment, refer to paragraph 4-110 of P360180E1 manual or paragraph 4-117 of P3601.8E1 manual or paragraph 4-88 of P3602.0E1 manual.

5. Remote Level and Remote AM Tracking adjustments are required only when Attenuator Options 181, 182 or 183 are installed. Refer to Appendix A of P360180E1, P3601.8E1 or P3602.0E1 manuals for calibration.

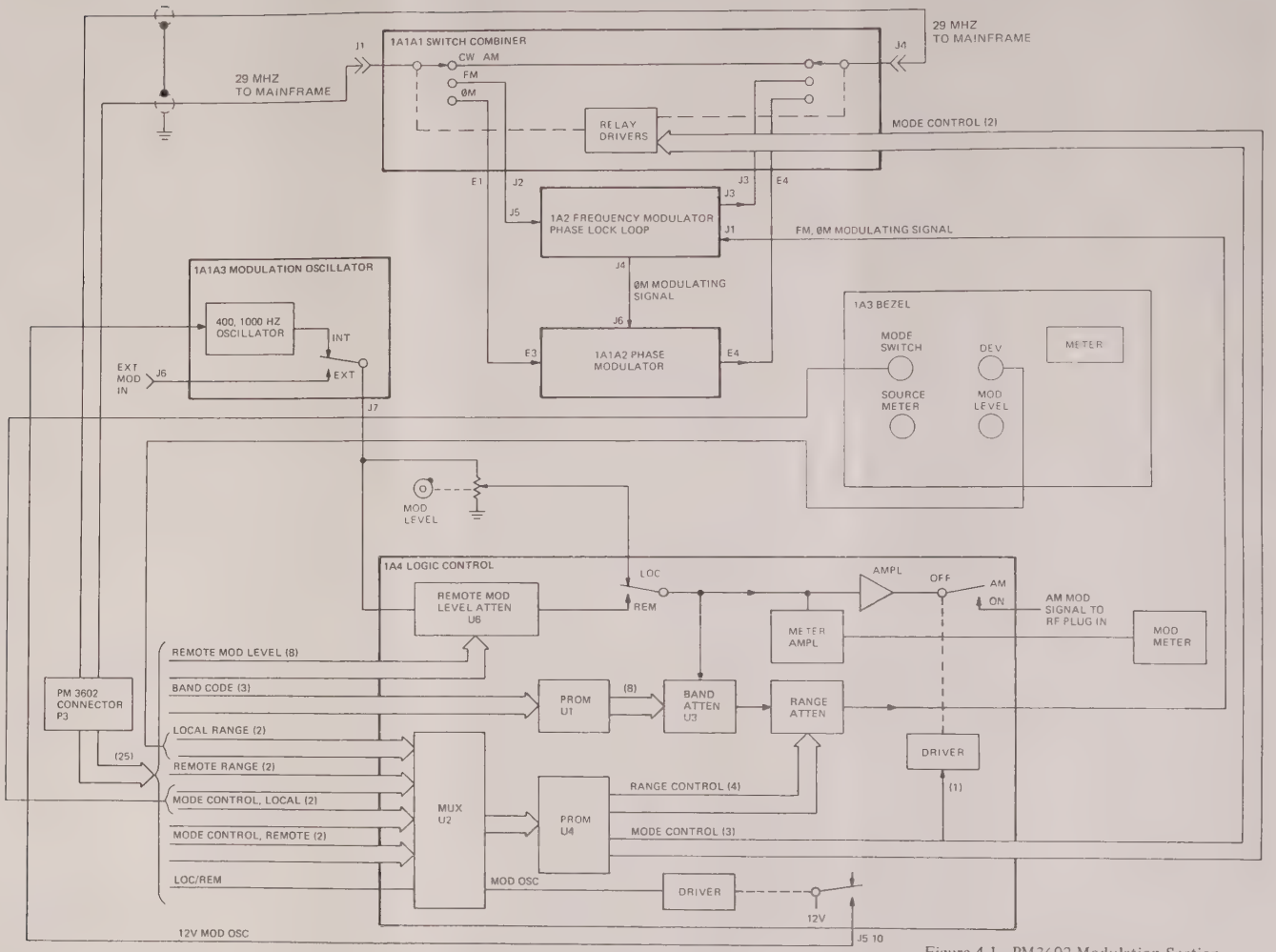


Figure 4-1. PM3602 Modulation Section, Servicing Block Diagram

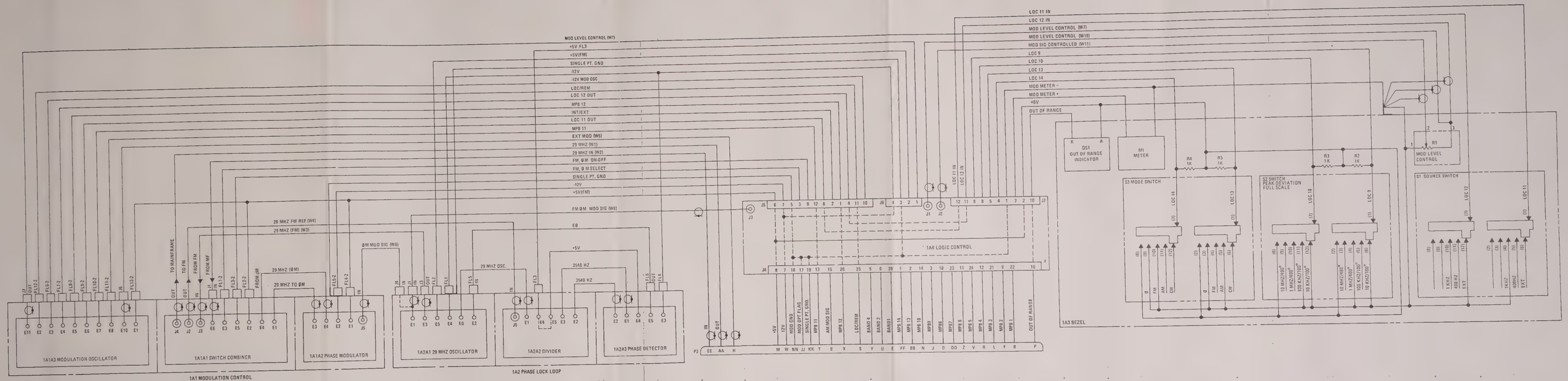


Figure 4-2. PM3602 Modulation Section, Interconnection Diagram

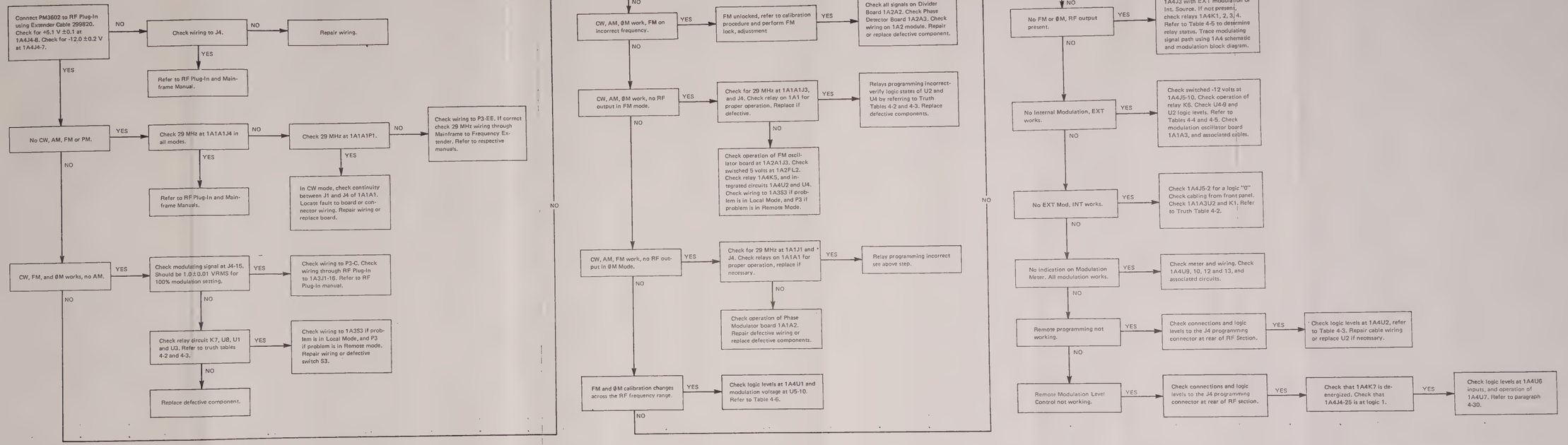
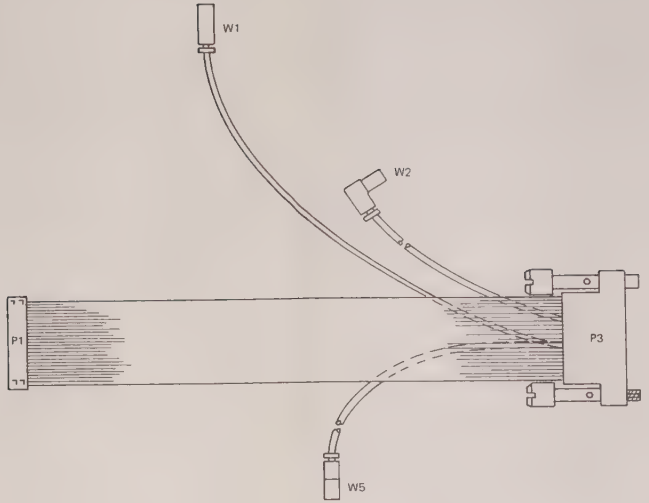
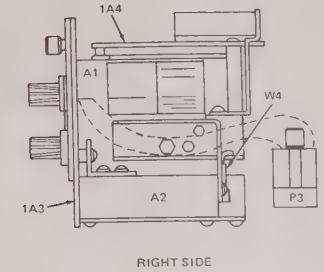

Connect PM3602 to RF Plug-In using Extender Cable 299820. Check for 45.1 V ±0.1 at 1A4J4-8. Check for -12.0 ±0.2 V at 1A4J4-7.
NO
Check wiring to J4.
NO
Repair wiring.
YES
Refer to RF Plug-In and Main-frame Manual.
YES
No CW, AM, FM or PM.
YES
Check 29 MHz at 1A1A1J4 in all modes.
NO
Check 29 MHz at 1A1A1P1.
NO
Check wiring to P3-EE. If correct check 29 MHz wiring through Mainframe to Frequency Ex-tender. Refer to respective manuals.
YES
Refer to RF Plug-In and Main-frame Manuals.
YES
In CW mode, check continuity between J1 and J4 of 1A1A1. Locate fault to board or con-nector wiring. Repair wiring or replace board.
NO
CW, FM, and ØM works, no AM.
YES
Check modulating signal at J4-15. Should be 1.0±0.01 VRMS for 100% modulation setting.
YES
Check wiring to P3-C. Check wiring through RF Plug-In to 1A3J1-16. Refer to RF Plug-In manual.
NO
Check relay circuit K7, U8, U1 and U3. Refer to truth tables 4-2 and 4-3.
YES
Check wiring to 1A3S3 if prob-lem is in Local Mode, and P3 if problem is in Remote mode. Repair wiring or defective switch S3.
NO
Replace defective component.
NO
CW, AM, ØM work, FM on incorrect frequency.
YES
FM unlocked, refer to calibration procedure and perform FM lock, adjustment
YES
Check all signals on Divider Board 1A2A2. Check Phase Detector Board 1A2A3. Check wiring on 1A2 module. Repair or replace defective component.
NO
CW, AM, ØM work, no RF output in FM mode.
YES
Check for 29 MHz at 1A1A1J3, and J4. Check relay on 1A1 for proper operation. Replace if defective.
YES
Relays programming incorrect-verify logic states of U2 and U4 by referring to Truth Tables 4-2 and 4-3. Replace defective components.
NO
Check operation of FM oscil-lator board at 1A2A1J3. Check switched 5 volts at 1A2FL2. Check relay 1A4K5, and in-tegrated circuits 1A4U2 and U4. Check wiring to 1A3S3 if prob-lem is in Local Mode, and P3 if problem is in Remote Mode.
NO
CW, AM, FM work, no RF out-put in ØM Mode.
YES
Check for 29 MHz at 1A1J1 and J4. Check relays on 1A1A1 for proper operation, replace if necessary.
YES
Relay programming incorrect see above step.
NO
Check operation of Phase Modulator board 1A1A2. Repair defective wiring or replace defective components.
NO
FM and ØM calibration changes across the RF frequency range.
YES
Check logic levels at 1A4U1 and modulation voltage at U5-10. Refer to Table 4-6.
NO
NO
No FM or ØM, RF output present.
YES
Check for modulation signal at 1A4J3 with EXT modulation or Int. Source. If not present, check relays 1A4K1, 2, 3, 4. Refer to Table 4-5 to determine relay status. Trace modulating signal path using 1A4 schematic and modulation block diagram.
NO
No Internal Modulation, EXT works.
YES
Check switched -12 volts at 1A4J5-10. Check operation of relay K6. Check U4-9 and U2 logic levels. Refer to Tables 4-4 and 4-5. Check modulation oscillator board 1A1A3, and associated cables.
NO
No EXT Mod, INT works.
YES
Check 1A4J5-2 for a logic "0" Check cabling from front panel. Check 1A1A3U2 and K1. Refer to Truth Table 4-2.
NO
No indication on Modulation Meter. All modulation works.
YES
Check meter and wiring. Check 1A4U9, 10, 12 and 13, and associated circuits.
NO
Remote programming not working.
YES
Check connections and logic levels to the J4 programming connector at rear of RF Section.
YES
Check logic levels at 1A4U2, refer to Table 4-3. Repair cable wiring or replace U2 if necessary.
NO
Remote Modulation Level Control not working.
YES
Check connections and logic levels to the J4 programming connector at rear of RF section.
YES
Check that 1A4K7 is de-energized. Check that 1A4J4-25 is at logic 1.
YES
Check logic levels at 1A4U6 inputs, and operation of 1A4U7. Refer to paragraph 4-30.

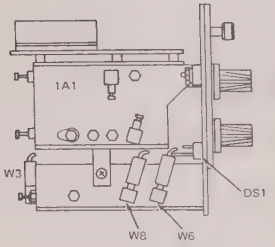
Figure 4-3. Diagnostic Troubleshooting Chart



FROM	TO	COLOR	FROM	TO	COLOR
P1-1	P3-FF	BROWN	P1-22	P3-B	GRAY
P1-14	P3-N	RED	P1-10	P3-D	WHITE
P1-2	P3-BB	ORG	P1 23	P3 DD	BLACK
P1-15	P3-C	YEL	P1-11	P3-Z	BROWN
P1-3	P3-J	GREEN	P1-24	P3-V	RED
P1-16	P3-P	BLUE	P1-12	P3-R	ORG
P1-4	P3-A	VIOLET	P1-25	P3-S	YEL
P1-17	P3-JJ	GRAY	P1-15	P3 T	GREEN
P1-5	P3-Y	WHITE	P1-26	P3 X	BLUE
P1-18	P3-NN	BLACK		P3 AA	COAX
P1-6	P3-U	BROWN		P3 EE	COAX
P1-19	P3-KK	RED		P3 H	COAX
P1-7	P3-W	ORG		P3-G	
P1-20	P3-E	YEL		P3 K	
P1-8	P3-M	GREEN		P3 CC	
P1-21	P3-L	BLUE		P3 GG	
P1-9	P3-F	VIOLET		P3-HH	

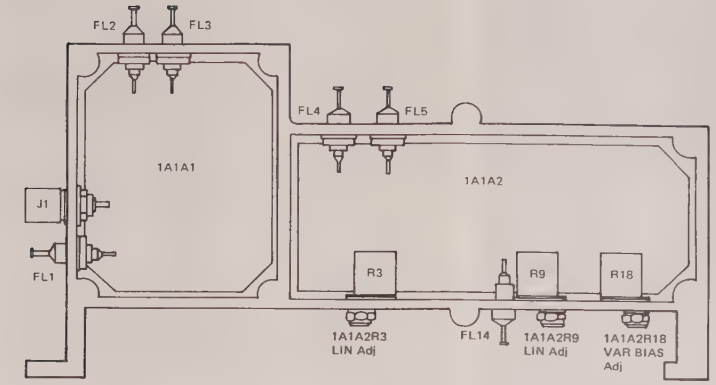


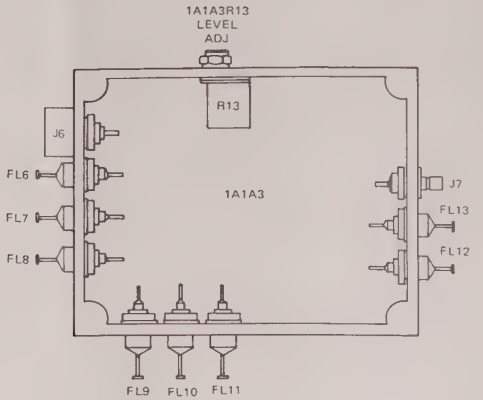
RIGHT SIDE

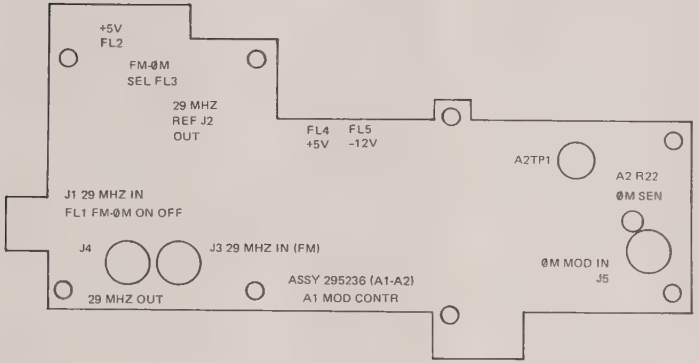


LEFT SIDE

Figure 4-4. PM3602 Modulation Section, Assembly Location Diagram







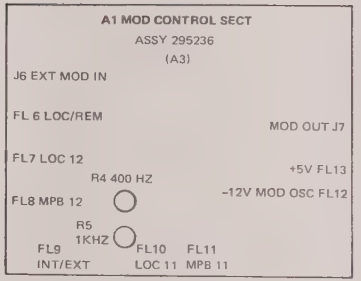


Figure 4-5. Modulation Control Section 1A1, Adjustable and Fixed Components Location Diagram

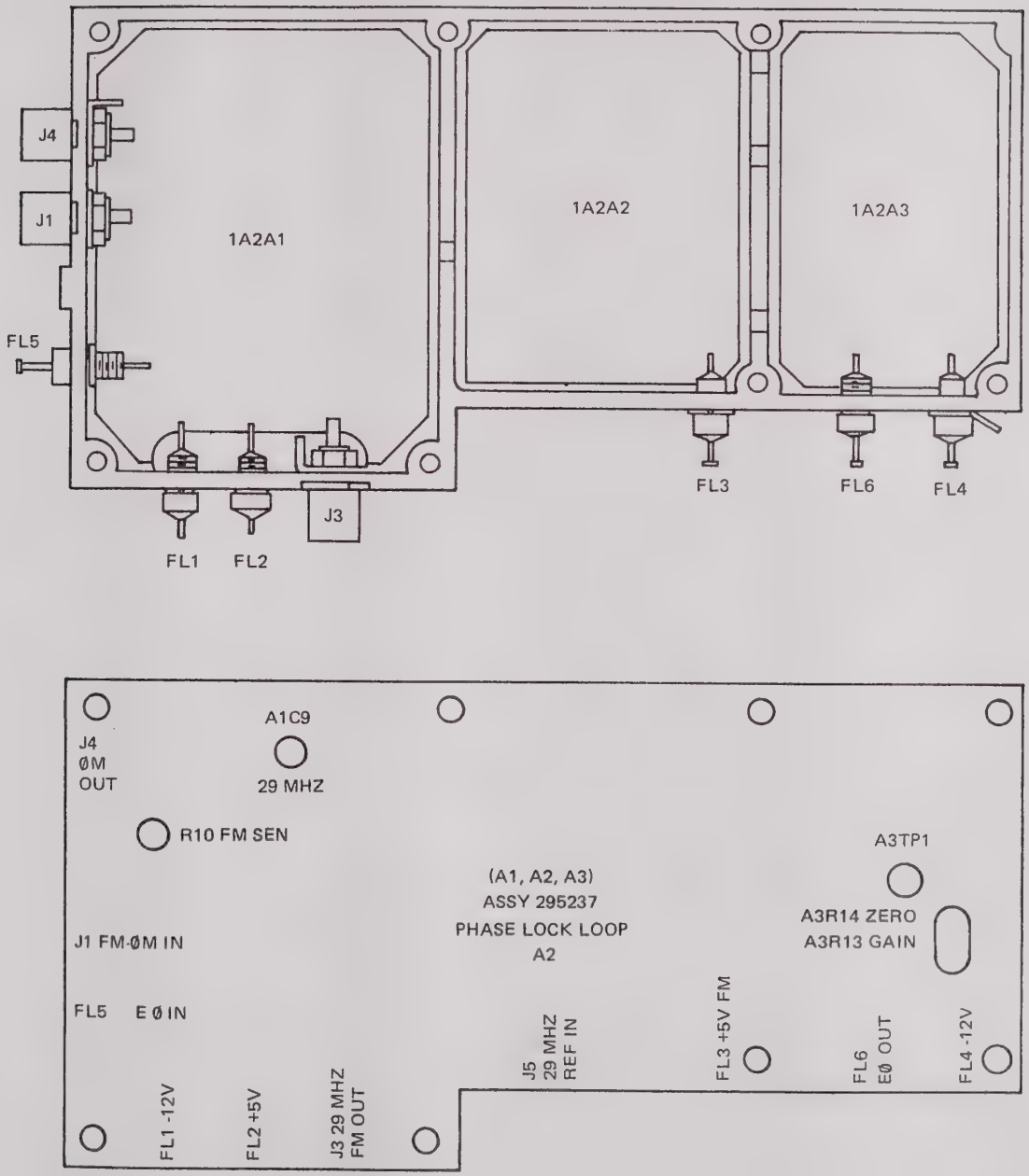
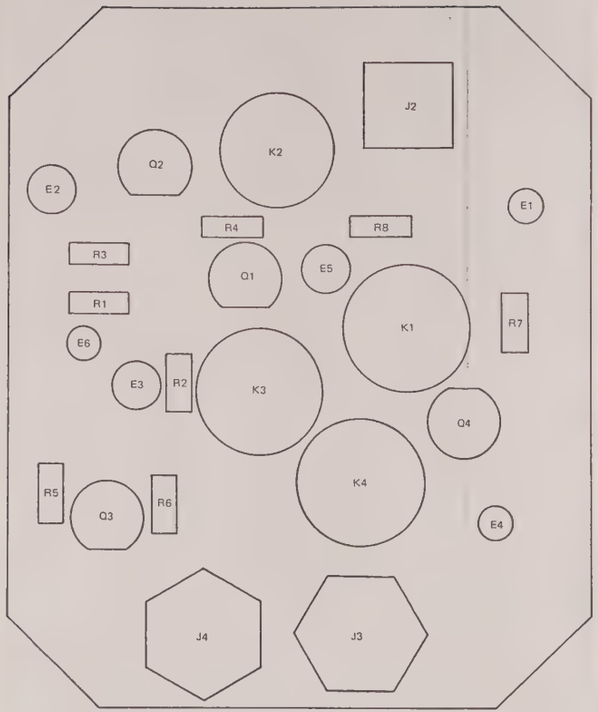
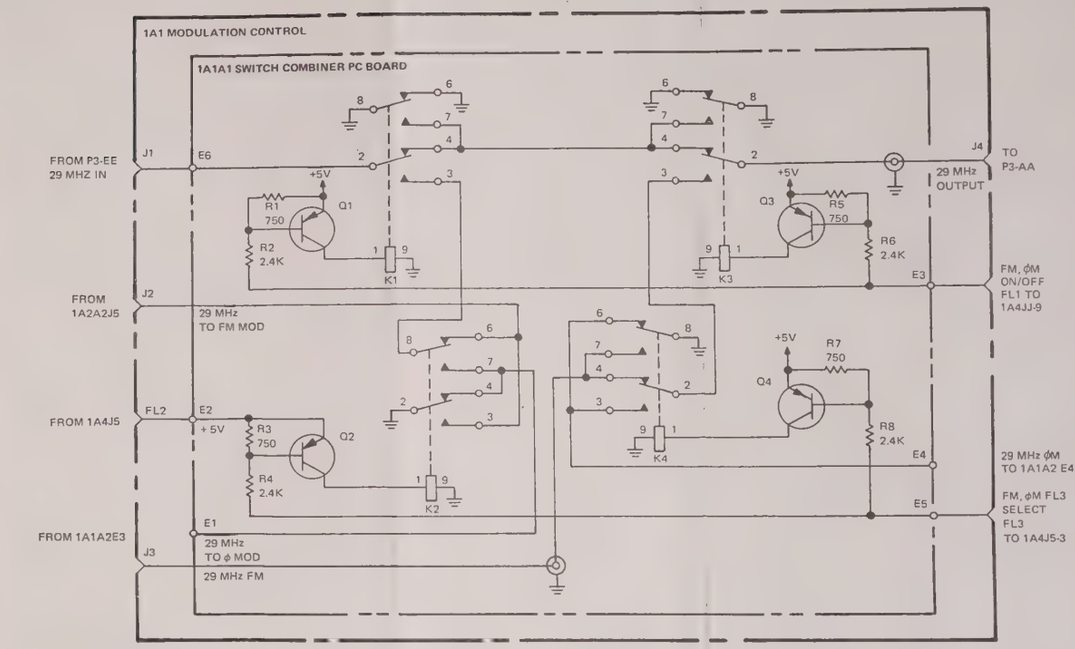


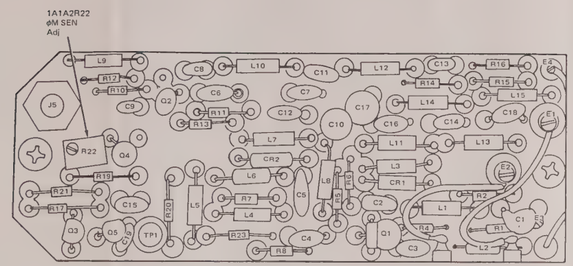
Figure 4-9. Phase Lock Loop 1A2, Adjustable and Fixed Components Location Diagram

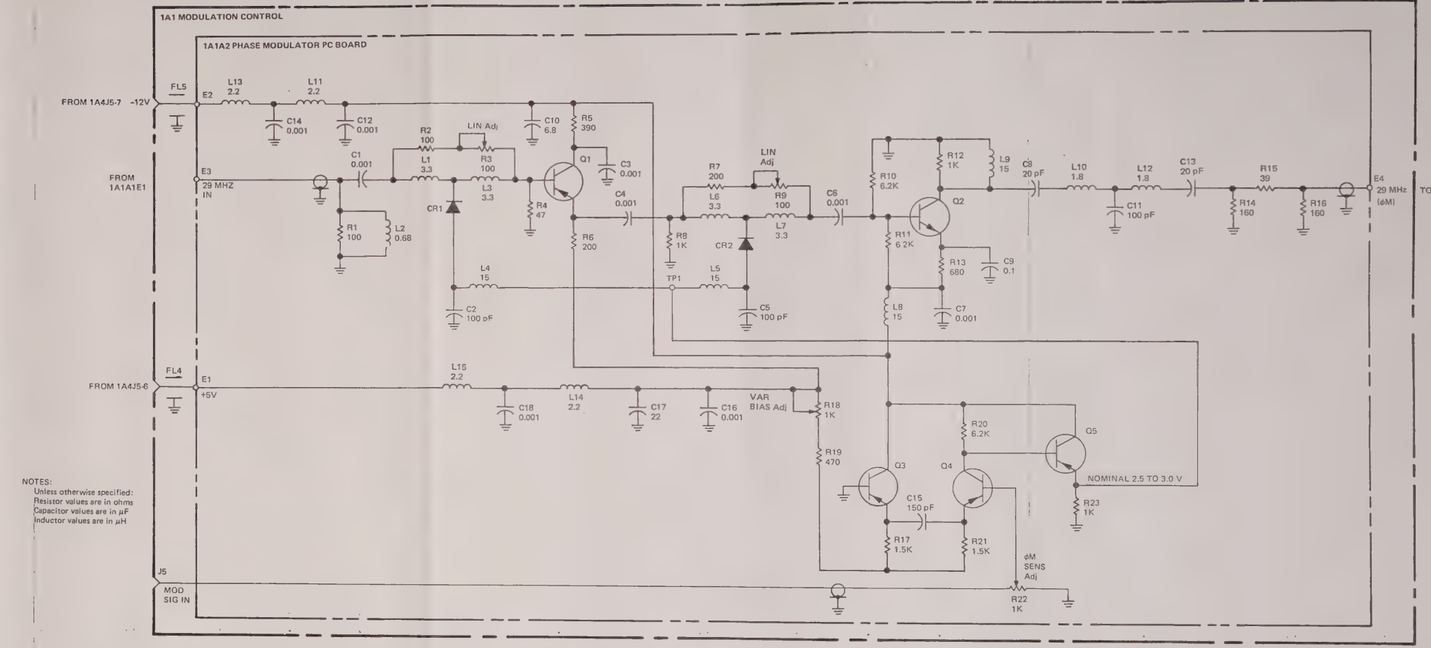




NOTE:
UNLESS OTHERWISE SPECIFIED:
RESISTOR VALUES ARE IN OHMS

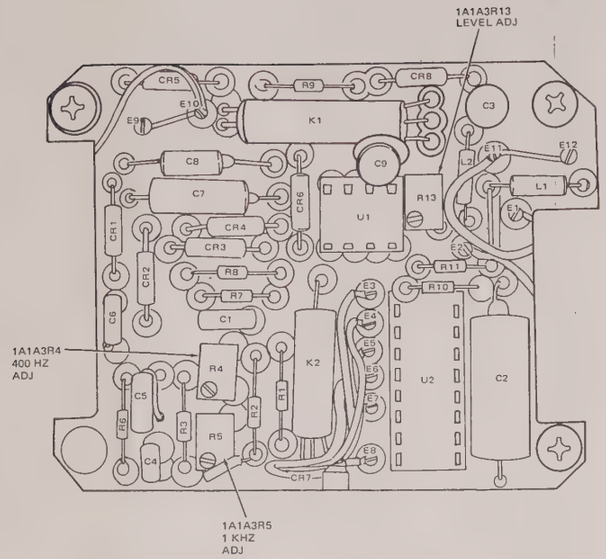
Figure 4-6. Switch Combiner PC Board 1A1A1, Schematic Diagram





NOTES:
Unless otherwise specified:
Resistor values are in ohms
Capacitor values are in μF
Inductor values are in μH

Figure 4-7. Phase Modulator PC Board 1A1A2, Schematic Diagram



Notes:
Unless otherwise specified:
Resistor values are in ohms
Capacitor values are in μF
Inductor values are in μH

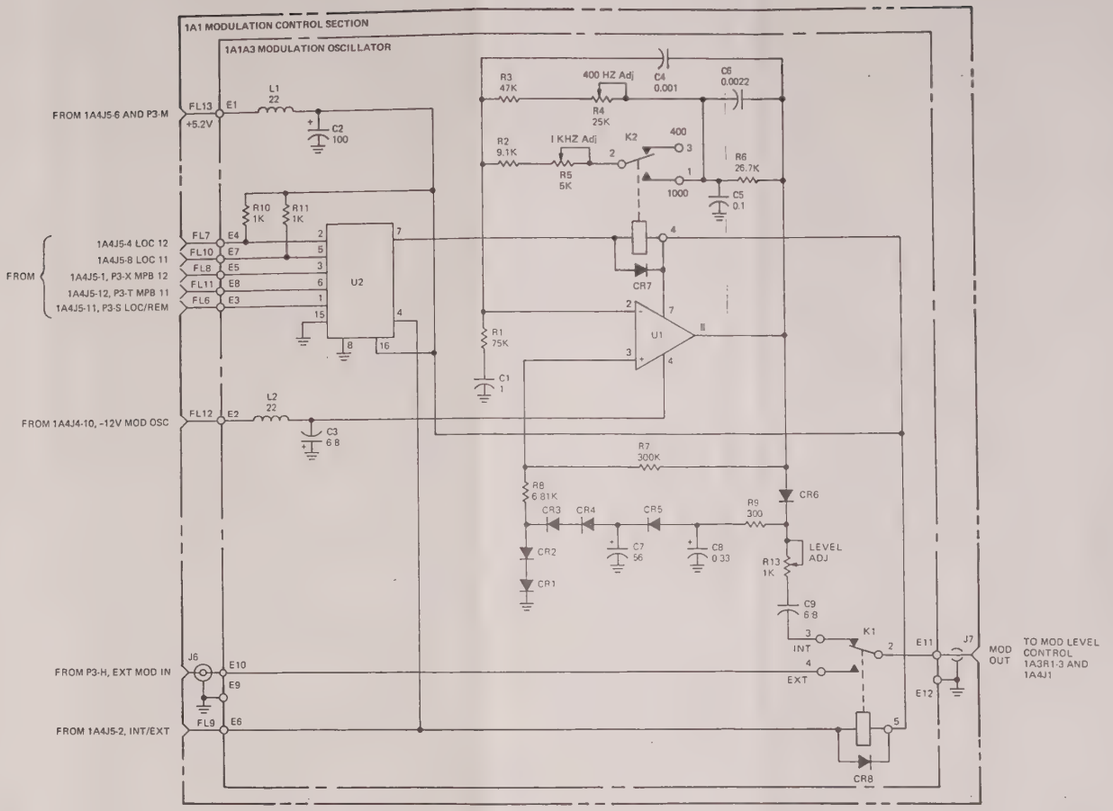
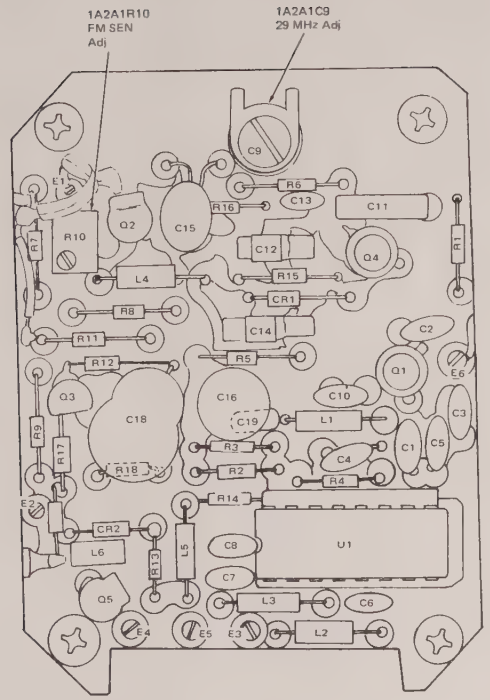


Figure 4-8. Modulation Oscillator PC Board 1A1A3, Schematic Diagram



Notes:
Unless otherwise specified:
Resistor values are in ohms
Capacitor values are in μF
Inductor values are in μH

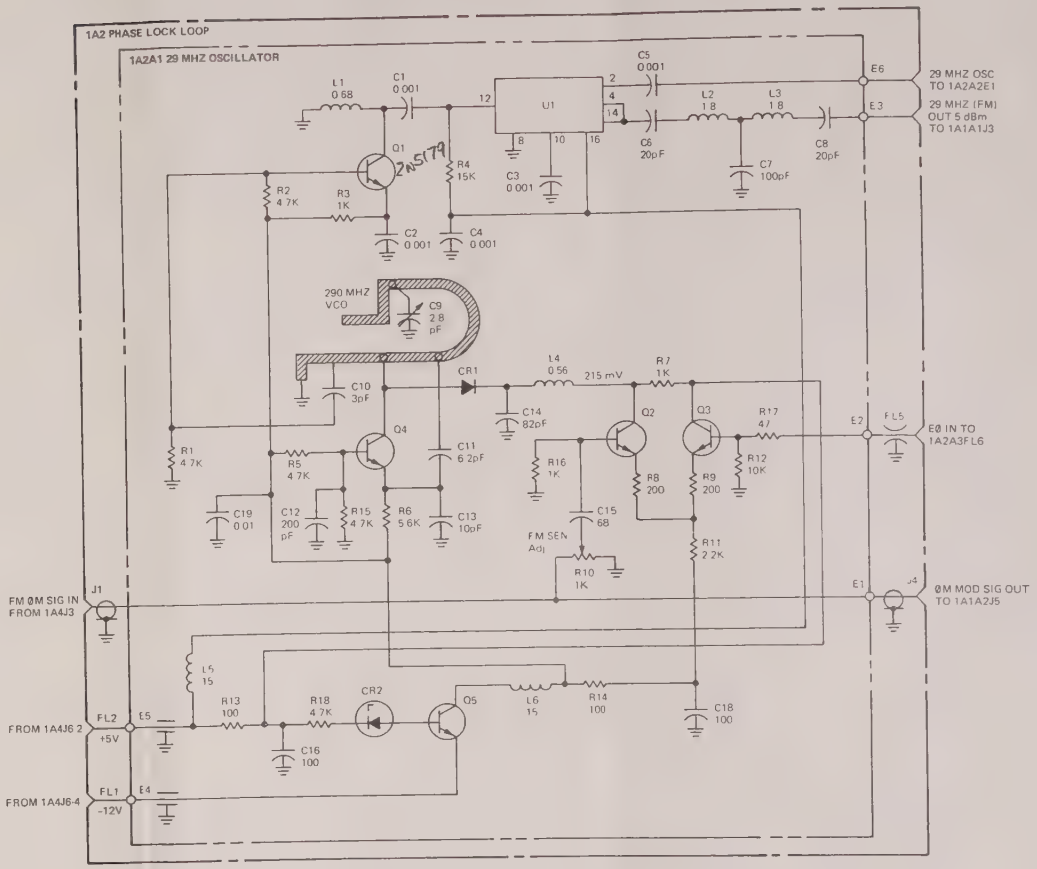
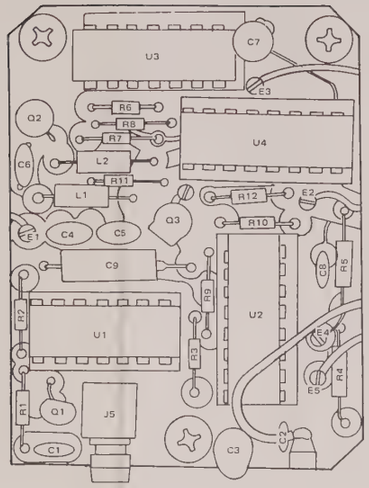


Figure 4-10. 29 MHz Oscillator PC Board 1A2A1, Schematic Diagram



NOTES:
Unless otherwise specified:
Resistor values are in ohms
Capacitor values are in μF
Inductor values are in μH

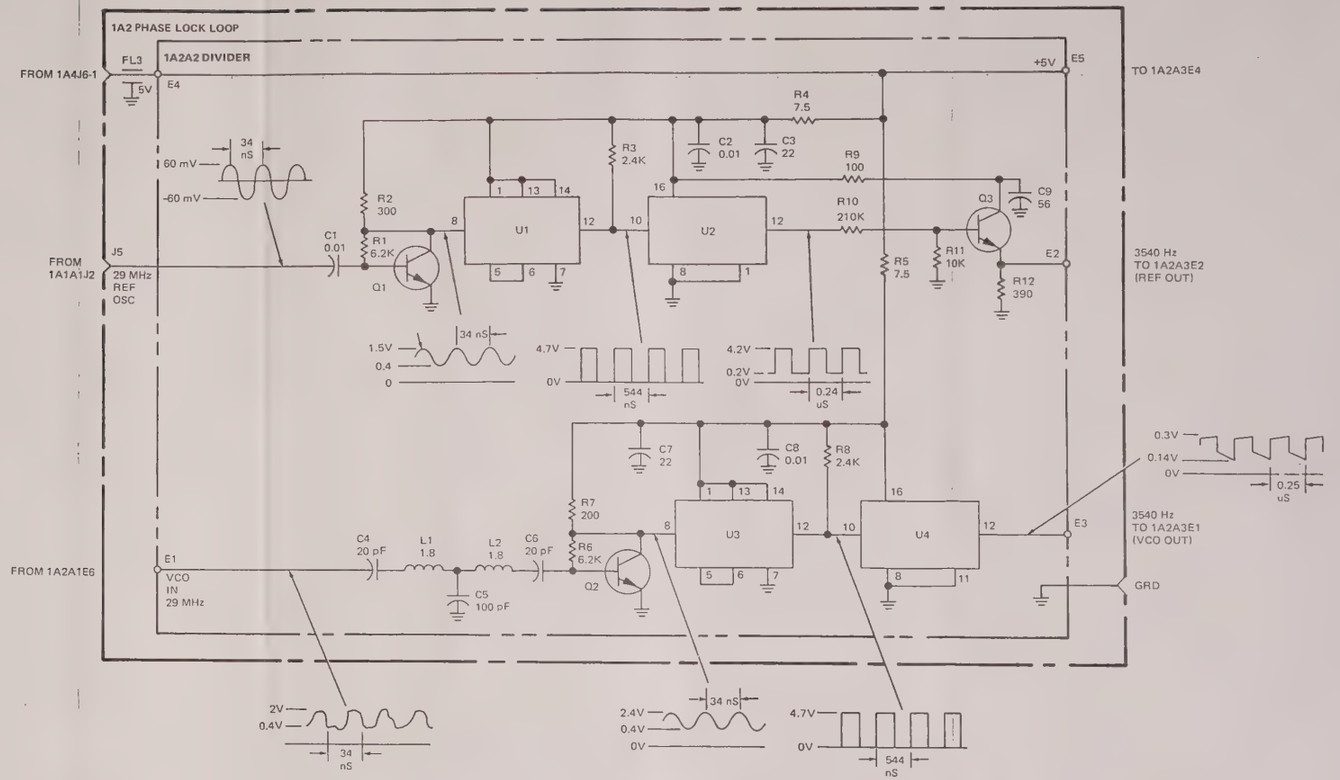
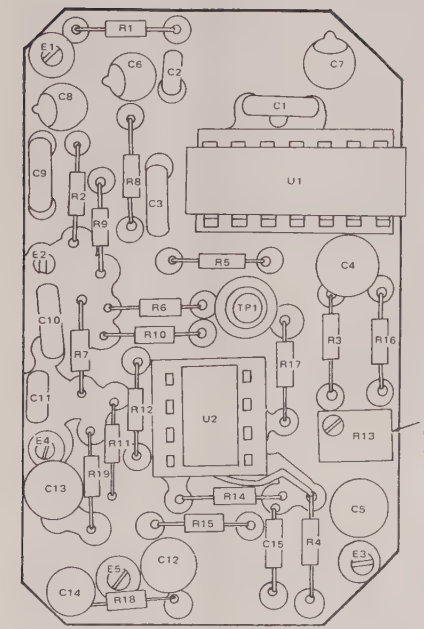
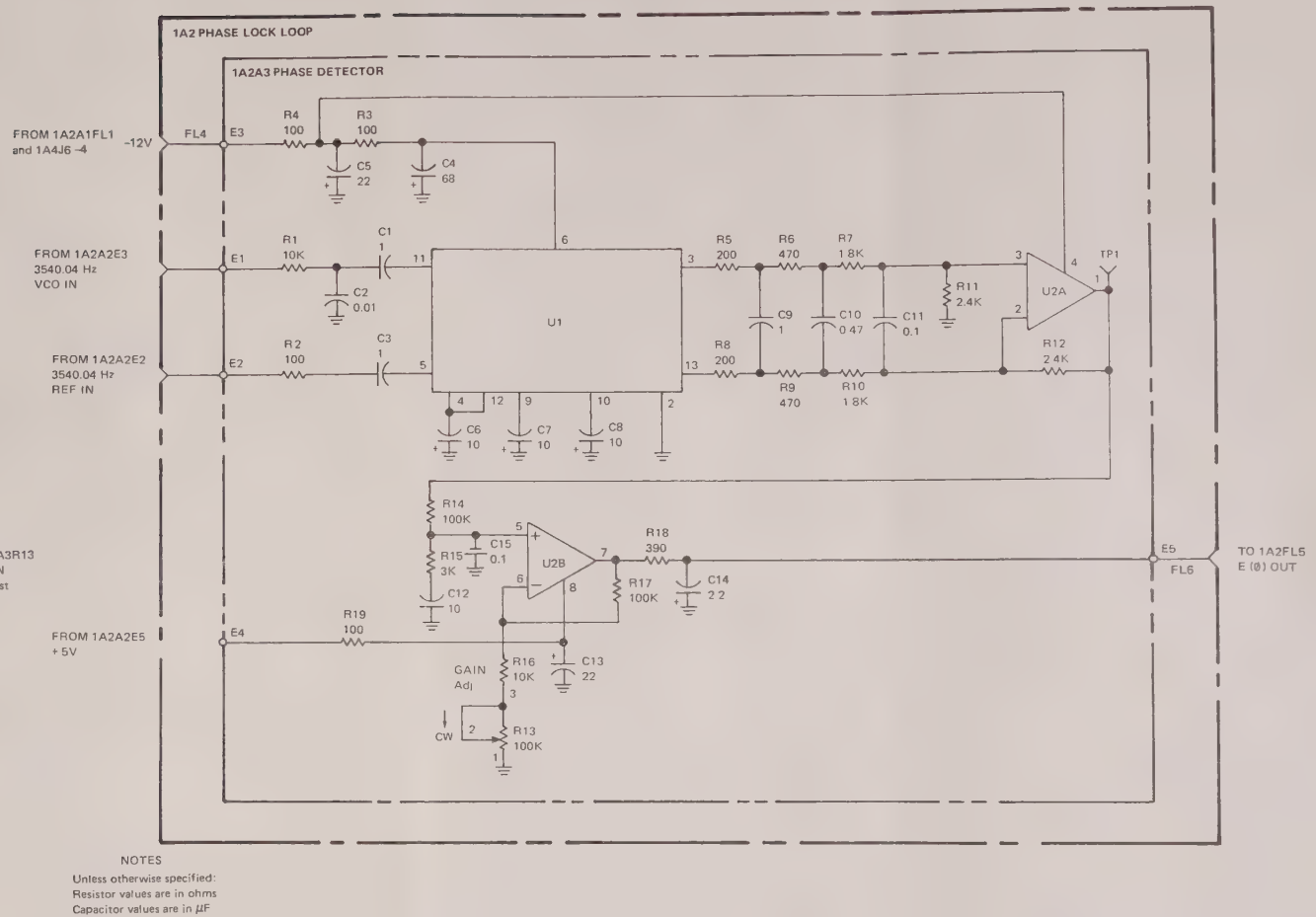


Figure 4-11. Divider PC Board 1A2A2, Schematic Diagram

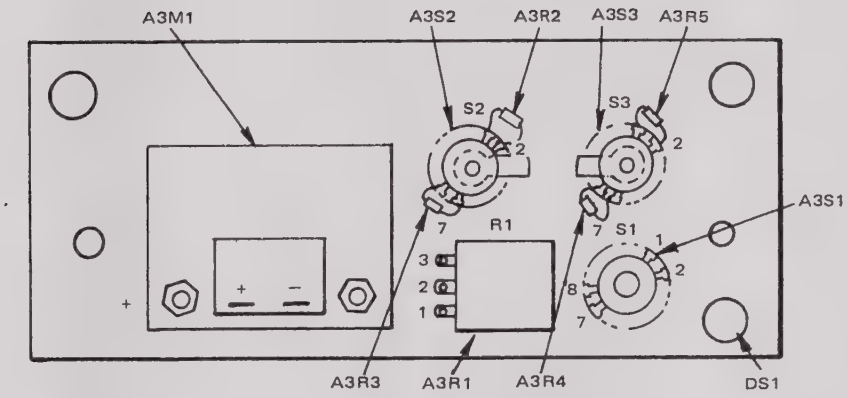




NOTES

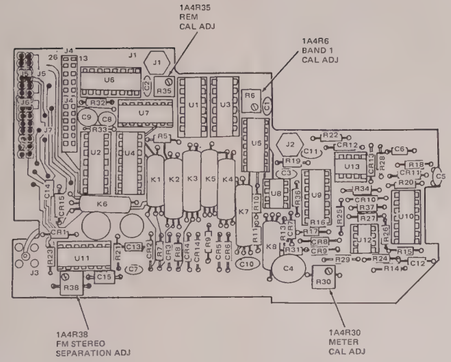
Unless otherwise specified:
Resistor values are in ohms
Capacitor values are in μF

Figure 4-12. Phase Detector PC Board 1A2A3, Schematic Diagram



(a)

Figure 4-13. Bezel Assembly 1A3, Component Location Diagram



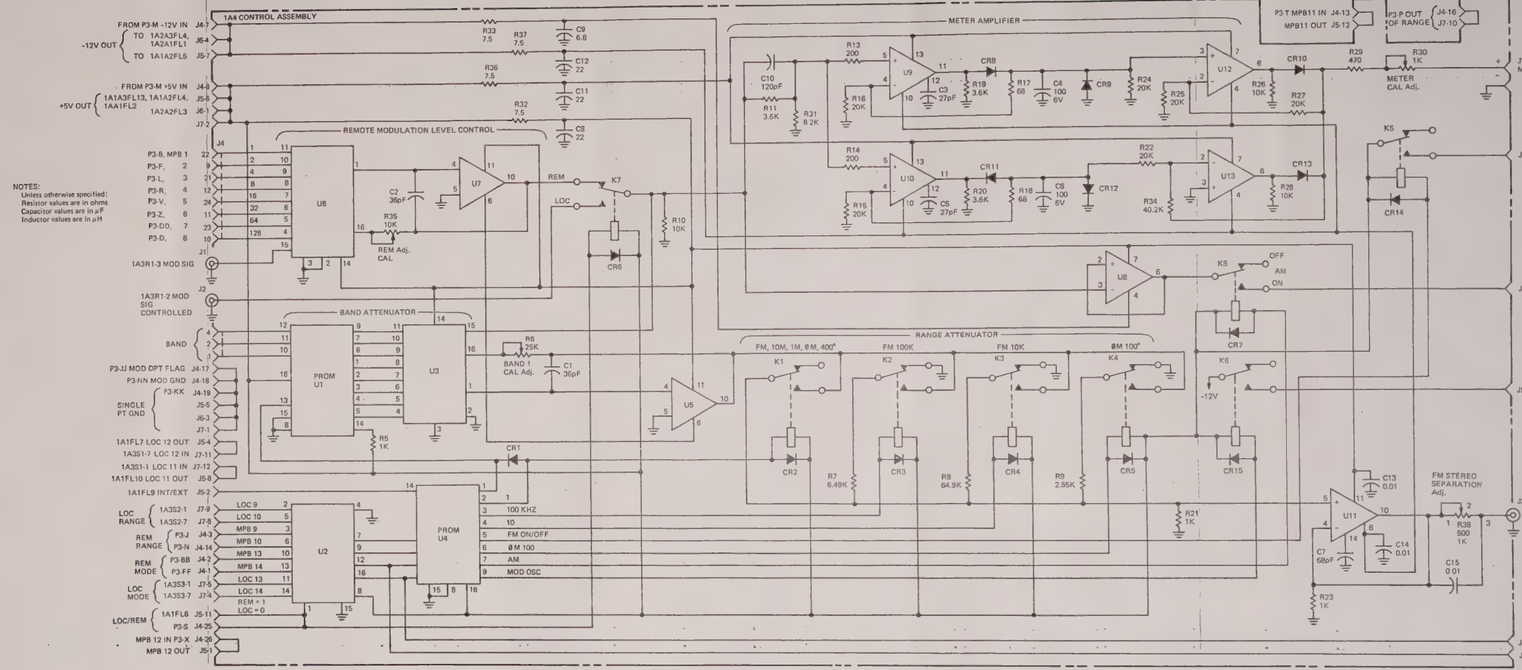


Figure 4-14. Control Assembly 1A4, Schematic Diagram

SECTION 5

REPLACEABLE PARTS LIST

5-1. INTRODUCTION

5-2. This section contains the replaceable parts list for the AILTECH PM3602 AM/FM/Phase Modulation Section. The parts list is in reference designation order. The parts list (Table 5-1) contains the reference designation, AILTECH part number, quantity, description, manufacturers code, and manufacturers part number. Table 5-2 lists the manufacturers code and the manufacturers name and address.

Table 5-1. Replaceable Parts List

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	295206	1	MODULATION SECTION, PM3602	56872	295206
1A1	295236	1	MODULATION CONTROL ASSEMBLY	56872	295236
1A2	295237	1	PHASE LOCK LOOP ASSEMBLY	56872	295237
1A3	295238	1	BEZEL ASSEMBLY	56872	295238
1A4	295234	1	CONTROL ASSEMBLY	56872	295234
DS1	293273	1	LED (RED)	50436	5082-4655
	295241	1	CABLE ASSEMBLY, INTERFACE	56872	295241
P1	294410	1	CONNECTOR, 26 PIN	00779	86905-1
P3	294837	1	SOCKET, 34 PIN	00779	200838-3
W1	299297-48	1	RF CABLE	56872	299297-48
W2	299297-49	1	RF CABLE	56872	299297-49
W5	299297-52	1	RF CABLE	56872	299297-52
W3	299297-50	1	CABLE ASSEMBLY, COAXIAL	56872	299297-50
W4	299297-51	1	CABLE ASSEMBLY, COAXIAL	56872	299297-51
W6	299297-53	1	CABLE ASSEMBLY, COAXIAL	56872	299297-53
W8	299297-55	1	CABLE ASSEMBLY, COAXIAL	56872	299297-55
1A1	295236	1	MODULATION CONTROL ASSEMBLY	56872	295236
A1	295232	1	SWITCH COMBINER PC BOARD	56872	295232
A2	295211	1	PHASE MODULATOR PC BOARD	56872	295211
A3	295242	1	MODULATION OSCILLATOR PC BOARD	56872	295242
FL1	294211	14	FILTERCON	72982	1250-003
FL2	294211		FILTERCON	72982	1250-003
FL3	294211		FILTERCON	72982	1250-003
FL4	294211		FILTERCON	72982	1250-003
FL5	294211		FILTERCON	72982	1250-003
FL6	294211		FILTERCON	72982	1250-003
FL7	294211		FILTERCON	72982	1250-003
FL8	294211		FILTERCON	72982	1250-003
FL9	294211		FILTERCON	72982	1250-003
FL10	294211		FILTERCON	72982	1250-003
FL11	294211		FILTERCON	72982	1250-003
FL12	294211		FILTERCON	72982	1250-003
FL13	294211		FILTERCON	72982	1250-003
FL14	294211		FILTERCON	72982	1250-003
J1	295396	2	CONNECTOR, RIGHT ANGLE	98291	51-347-0000
J6	295396		CONNECTOR, RIGHT ANGLE	98291	51-347-0000
J7	299233	1	CONNECTOR, RF	98291	51-045-0000

Table 5-1. Replaceable Parts List (Continued)

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1A1A1	295232		SWITCH COMBINER PC BOARD (Figure 4-6)	56872	295232
E1	293310	6	TERMINAL	71279	1597-2-01
E2	293310		TERMINAL	71279	1597-2-01
E3	293310		TERMINAL	71279	1597-2-01
E4	293310		TERMINAL	71279	1597-2-01
E5	293310		TERMINAL	71279	1597-2-01
E6	293310		TERMINAL	71279	1597-2-01
J2	299235	1	CONNECTOR, RF, RIGHT ANGLE	98291	51-353-0000
J3	294426	2	CONNECTOR, RF	98291	51-051-0000
J4	294426		CONNECTOR, RF	98291	51-051-0000
K1	294200	4	RELAY, DPDT	11532	712D-5
K2	294200		RELAY, DPDT	11532	712D-5
K3	294200		RELAY, DPDT	11532	712D-5
K4	294200		RELAY, DPDT	11532	712D-5
Q1	294153	4	TRANSISTOR	04713	2N4126
Q2	294153		TRANSISTOR	04713	2N4126
Q3	294153		TRANSISTOR	04713	2N4126
Q4	294153		TRANSISTOR	04713	2N4126
R1	299700-751	4	RESISTOR, 750Ω, 1/8W, 5%	01121	RC05GF751J
R2	299700-242	4	RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
R3	299700-751		RESISTOR, 750Ω, 1/8W, 5%	01121	RC05GF751J
R4	299700-242		RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
R5	299700-751		RESISTOR, 750Ω, 1/8W, 5%	01121	RC05GF751J
R6	299700-242		RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
R7	299700-751		RESISTOR, 750Ω, 1/8W, 5%	01121	RC05GF751J
R8	299700-242		RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
1A1A2	295211	1	PHASE MODULATOR PC BOARD (Figure 4-7)	56872	295211
C1	299243	9	CAPACITOR .001μF	56289	CK60AW102M
C2	299241-101	4	CAPACITOR 100 pF	72136	DM5-101J
C3	299243		CAPACITOR .001μF	56289	CK60AW102M
C4	299243		CAPACITOR .001μF	56289	CK60AW102M
C5	299241-101		CAPACITOR 100 pF	72136	DM5-101J
C6	299243		CAPACITOR .001μF	56289	CK60AW102M
C7	299243		CAPACITOR .001μF	56289	CK60AW102M
C8	299241-200	2	CAPACITOR 20pF	72136	DM5CC-200J
C9	299245-1	1	CAPACITOR 0.1μF	72982	8121-050-651-104M
C10	299240-1	1	CAPACITOR 6.8μF	31433	T368B225M035AS
C11	299241-101		CAPACITOR 100pF	72136	DM5-101J
C12	299243		CAPACITOR .001μF	56289	CK60AW102M
C13	299241-200		CAPACITOR 20pF	72136	DM5CC-200J
C14	299243		CAPACITOR .001μF	56289	CK60AW102M
C15	299250-151	1	CAPACITOR 150pF	14655	CM04FD151J03
C16	299243		CAPACITOR .001μF	56289	CK60AW102M
C17	299240-2	1	CAPACITOR 22μF	31433	T368B226M015AS
C18	299243		CAPACITOR .001μF	56289	CK60AW102M
C19	299241-101		CAPACITOR 100pF	72136	DM5FY-101J
CR1	294447	2	DIODE	18518	ZC803
CR2	294447		DIODE	18518	ZC803
E1	293310	4	TERMINAL	71279	1597-2-01
E2	293310		TERMINAL	71279	1597-2-01
E3	293310		TERMINAL	71279	1597-2-01
E4	293310		TERMINAL	71279	1597-2-01
J5	294426	1	CONNECTOR	98291	51-051-0000
L1	299237-32	4	INDUCTOR, 3.3μH	99800	1025-32
L2	299237-16	1	INDUCTOR, .68μH	99800	1025-16
L3	299237-32		INDUCTOR, 3.3μH	99800	1025-32
L4	299237-48	4	INDUCTOR, 15μH	99800	1025-48
L5	299237-48		INDUCTOR, 15μH	99800	1025-48
L6	299237-32		INDUCTOR, 3.3μH	99800	1025-32
L7	299237-32		INDUCTOR, 3.3μH	99800	1025-32

Table 5-1. Replaceable Parts List (Continued)

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1A1A2L8	299237-48		INDUCTOR, 15μH	99800	1025-48
L9	299237-48		INDUCTOR, 15μH	99800	1025-48
L10	299237-26	2	INDUCTOR, 1.8μH	99800	1025-26
L11	299237-28	4	INDUCTOR, 2.2μH	99800	1025-28
L12	299237-26		INDUCTOR, 1.8μH	99800	1025-26
L13	299237-28		INDUCTOR, 2.2μH	99800	1025-28
L14	299237-28		INDUCTOR, 2.2μH	99800	1025-28
L15	299237-28		INDUCTOR, 2.2μH	99800	1025-28
Q1	294153-001	4	TRANSISTOR	04713	2N4126
Q2	294172-001	1	TRANSISTOR	04713	MPS918
Q3	294153-001		TRANSISTOR	04713	2N4126
Q4	294153-001		TRANSISTOR	04713	2N4126
Q5	294153-001		TRANSISTOR	04713	2N4126
R1	299700-101	2	RESISTOR 100Ω, 1/8W, 5%	01121	RC05GF101J
R2	299700-101		RESISTOR 100Ω, 1/8W, 5%	01121	RC05GF101J
R3	294473-101	2	RESISTOR, VARIABLE 100Ω	80294	3290L-1-101M
R4	299700-470	1	RESISTOR 47Ω, 1/8W, 5%	01121	RC05GF470J
R5	299700-391	1	RESISTOR 390Ω, 1/8W, 5%	01121	RC05GF391J
R6	299700-201	2	RESISTOR 200Ω, 1/8W, 5%	01121	RC05GF201J
R7	299701-201		RESISTOR 200Ω, 1/8W, 5%	01121	RC05GF201J
R8	299700-102	2	RESISTOR 1K, 1/8W, 5%	01121	RC05GF102J
R9	294473-101		RESISTOR, VARIABLE 100Ω	80294	3290L-1-101M
R10	299700-622	2	RESISTOR 6.2K, 1/8W, 5%	01121	RC05GF622J
R11	299700-622		RESISTOR 6.2K, 1/8W, 5%	01121	RC05GF622J
R12	299700-102		RESISTOR 1K, 1/8W, 5%	01121	RC05GF102J
R13	299700-681	1	RESISTOR 680Ω, 1/8W, 5%	01121	RC05GF681J
R14	299700-161	2	RESISTOR 160Ω, 1/8W, 5%	01121	RC05GF161J
R15	299700-390	1	RESISTOR 39Ω, 1/8W, 5%	01121	RC05GF390J
R16	299700-161		RESISTOR 160Ω, 1/8W, 5%	01121	RC05GF161J
R17	294095	2	RESISTOR 1.5K, 1/8W, 2%	01121	RLR05C152GM
R18	294473-102	1	RESISTOR, VARIABLE 1K	80294	3290L-1-102M
R19	294096	1	RESISTOR 470Ω, 1/8W, 2%	01121	RLR05C471GM
R20	294097	1	RESISTOR 6.2K, 1/8W, 2%	01121	RLR05C622GM
R21	294095		RESISTOR 1.5K, 1/8W, 2%	01121	RLR05C152GM
R22	294093	1	RESISTOR, VARIABLE 1K	80294	3262W-1-102
R23	294098	1	RESISTOR 1K, 1/8W, 2%	01121	RLR05C102GM
1A1A3	295242	1	MODULATION OSCILLATOR PC BOARD (Figure 4-8)	56872	295242
C1	299245-7	1	CAPACITOR, 1μF	72982	8131-M058-651-105M
C2	294080	1	CAPACITOR, 100μF	56289	CSR13C107KM
C3	299240-1	2	CAPACITOR, 6.8μF	31433	T368B225M035AS
C4	299245-10	1	CAPACITOR, .001μF	72982	8121-M108-C0G0-102K
C5	299245-9	1	CAPACITOR, .1μF	72982	8131-M108-X7R0-104K
C6	299245-6	1	CAPACITOR, .0022μF	72982	8131-M108-C0G0-222K
C7	294079	1	CAPACITOR, 56μF	56289	CSR13B566KM
C8	294078	1	CAPACITOR, .33μF	56289	CSR13G-334KM
C9	299240-1		CAPACITOR, 6.8μF	31433	T368B225M035AS
CR1	293200	8	DIODE	01295	1N645
CR2	293200		DIODE	01295	1N645
CR3	293200		DIODE	01295	1N645
CR4	293200		DIODE	01295	1N645
CR5	293200		DIODE	01295	1N645
CR6	293200		DIODE	01295	1N645
CR7	293200		DIODE	01295	1N645
CR8	293200		DIODE	01295	1N645
E1	293306	8	TERMINAL	71279	1019-2-901
E2	293306		TERMINAL	71279	1019-2-901
E3	293306		TERMINAL	71279	1019-2-901
E4	293306		TERMINAL	71279	1019-2-901
E5	293306		TERMINAL	71279	1019-2-901
E6	293306		TERMINAL	71279	1019-2-901
E7	293306		TERMINAL	71279	1019-2-901
E8	293306		TERMINAL	71279	1019-2-901

Table 5-1. Replaceable Parts List (Continued)

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1A1A3K1	294197	1	RELAY, SPDT	32590	2275-5
K2	294196	1	RELAY, SPST	32590	2160S-5
L1	299237-52	2	INDUCTOR, 22μH	99800	1025-52
L2	299237-52		INDUCTOR, 22μH	99800	1025-52
R1	294089	1	RESISTOR, 75K, 1/8W, 2%	01121	RLR05C735GR
R2	294088	1	RESISTOR, 9.1K, 1/8W, 2%	01121	RLR05C912GR
R3	294054	1	RESISTOR, 47K, 1/8W, 2%	01121	RLR05C473GR
R4	294055	1	RESISTOR, VARIABLE, 25K	80294	3262W-1-253
R5	294086	1	RESISTOR, VARIABLE, 5K	80294	3262W-1-502
R6	294085	1	RESISTOR, 26.7K, 1/8W, 2%	01121	RLR05C273GR
R7	299700-304	1	RESISTOR, 300K, 1/8W, 5%	01121	RC05GF304J
R8	294084	1	RESISTOR, 6.81K, 1/8W, 2%	01121	RLR05C682GR
R9	294083	1	RESISTOR, 300Ω, 1/8W, 2%	01121	RLR05C301GR
R10	299700-102	2	RESISTOR, 1K, 1/8W, 5%	01121	RC05GF102J
R11	299700-102		RESISTOR, 1K, 1/8W, 5%	01121	RC05GF102J
R12			NOT USED		
R13	294473-102	1	RESISTOR, VARIABLE 1K	80294	3290L-1-102M
U1	293354-1	1	INTEGRATED CIRCUIT	18324	UA741C-Y
U2	293414	1	INTEGRATED CIRCUIT	01295	SN74157N
XU1	294565	1	IC SOCKET, 8 PIN	01295	C930810
XU2	294567	1	IC SOCKET, 16 PIN	01295	C931610
1A2	295237	1	PHASE LOCK LOOP ASSEMBLY (Figure 4-9)	56872	295237
A1	295273	1	29 MHz OSCILLATOR PC BOARD	56872	295273
A2	295213	1	DIVIDER PC BOARD	56872	295213
A3	295207	1	PHASE DETECTOR PC BOARD	56872	295207
FL1	294211	6	FILTERCON	72982	1250-003
FL2	294211		FILTERCON	72982	1250-003
FL3	294211		FILTERCON	72982	1250-003
FL4	294211		FILTERCON	72982	1250-003
FL5	294211		FILTERCON	72982	1250-003
FL6	294211		FILTERCON	72982	1250-003
J1	295396	3	CONNECTOR, RIGHT ANGLE	98291	51-347-0000
J3	295396		CONNECTOR, RIGHT ANGLE	98291	51-347-0000
J4	295396		CONNECTOR, RIGHT ANGLE	98291	51-347-0000
1A2A1	295273	1	29 MHz OSCILLATOR PC BOARD (Figure 4-10)	56872	295273
C1	299243-001	5	CAPACITOR, .001μF	56289	CK60AW102M
C2	299243-001		CAPACITOR, .001μF	56289	CK60AW102M
C3	299243-001		CAPACITOR, .001μF	56289	CK60AW102M
C4	299243-001		CAPACITOR, .001μF	56289	CK60AW102M
C5	299243-001		CAPACITOR, .001μF	56289	CK60AW102M
C6	299241-200	2	CAPACITOR DIPPED MICA, 20pF	72136	DM5CC-200J
C7	299241-101	1	CAPACITOR, DIPPED MICA, 100pF	72136	DM5FY-101J
C8	299241-200		CAPACITOR, DIPPED MICA, 20pF	72136	DM5CC-200J
C9	294070	1	CAPACITOR, AIR TRIMMER, 2.8pF	91293	6371
C10	299241-030	1	CAPACITOR, DIPPED MICA, 3pF	72136	DM5CC-030D
C11	299253-3	1	CAPACITOR, FIXED, PORCELAIN, 6.2pF	95275	VY10CA6R2JE
C12	294082	1	CAPACITOR, CHIP, 200pF	29990	100B201JMS
C13	299241-100	1	CAPACITOR, DIPPED MICA, 10pF	72136	DM5CC-100J
C14	294072	1	CAPACITOR, CHIP, 82pF	29990	100B820JMS
C15	299240-5	1	CAPACITOR, ELECTROLYTIC, 68μF	31433	T362C686M015AS
C16	299240-4	2	CAPACITOR, ELECTROLYTIC, 100μF	31433	T362D107M020AS
C17			NOT USED		
C18	299240-4		CAPACITOR, ELECTROLYTIC, 100μF	31433	T362D107M020AS
C19	299245-2	1	CAPACITOR, CERAMIC, .01μF	72982	8121-M058-651-103M
CR1	294448	1	DIODE	18518	ZC801
CR2	293266	1	DIODE	01295	IN5243B
E1	293306	6	TERMINAL	71279	1019-2-901
E2	293306		TERMINAL	71279	1019-2-901
E3	293306		TERMINAL	71279	1019-2-901

Table 5-1. Replaceable Parts List (Continued)

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1A2A1E4	293306		TERMINAL	71279	1019-2-901
E5	293306		TERMINAL	71279	1019-2-901
E6	293306		TERMINAL	71279	1019-2-901
L1	299237-16	1	INDUCTOR, .68μH	99800	1025-16
L2	299237-26	2	INDUCTOR, 1.8μH	99800	1025-26
L3	299237-26		INDUCTOR, 1.8μH	99800	1025-26
L4	299237-14	1	INDUCTOR, .56μH	99800	1025-14
L5	299237-48	2	INDUCTOR, 15μH	99800	1025-48
L6	299237-48		INDUCTOR, 15μH	99800	1025-48
Q1	299239-1	2	TRANSISTOR	04713	2N5179
Q2	294151	3	TRANSISTOR	04713	2N4124
Q3	294151		TRANSISTOR	04713	2N4124
Q4	299239-1		TRANSISTOR	04713	2N5179
Q5	294151		TRANSISTOR	04713	2N4124
R1	299700-472	3	RESISTOR, 4.7K, 1/8W,5%	01121	RC05GF472J
R2	299700-472		RESISTOR, 4.7K, 1/8W, 5%	01121	RC05GF472J
R3	299700-102	1	RESISTOR, 1K, 1/8W, 5%	01121	RC05GF102J
R4	299700-153	1	RESISTOR, 15K, 1/8W, 5%	01121	RC05GF153J
R5	294047	2	RESISTOR, 4.7K, 1/8W, 2%	01121	RLR05C472GM
R6	294048	1	RESISTOR, 5.6K, 1/8W, 2%	01121	RLR05C562GM
R7	294098	2	RESISTOR, 1/8W, 2%	01121	RLR05C102GM
R8	294049	2	RESISTOR, 200Ω, 1/8W, 2%	01121	RLR05C201GM
R9	294049		RESISTOR, 200Ω, 1/8W, 2%	01121	RLR05C201GM
R10	294093	1	RESISTOR VARIABLE, 1K	80294	3262W-1-102
R11	294050	1	RESISTOR, 2.2K, 1/8W, 2%	01121	RLR05C222GM
R12	299700-103	1	RESISTOR, 10K, 1/8W, 5%	01121	RC05GF103J
R13	299700-101	2	RESISTOR, 100Ω, 1/8W, 5%	01121	RC05GF101J
R14	299700-101		RESISTOR, 100Ω, 1/8W, 5%	01121	RC05GF101J
R15	294047		RESISTOR, 4.7K, 1/8W, 2%	01121	RLR05C472GM
R16	294098		RESISTOR, 1K, 1/8W, 2%	01121	RLR05C102GM
R17	299700-470	1	RESISTOR, 47Ω, 1/8W, 5%	01121	RC05GF470J
R18	299700-472		RESISTOR, 4.7K, 1/8W, 5%	01121	RC05GF472J
U1	293519	1	INTEGRATED CIRCUIT	52648	SP8685B
XU1	294567	1	SOCKET, IC, 16 PIN	01295	C931610
1A2A2	295213	1	DIVIDER PC BOARD (Figure 4-11)	56872	295213
C1	299245-2	3	CAPACITOR, CERAMIC, .01μF	72982	8121-M058-651-103M
C2	299245-2		CAPACITOR, CERAMIC, .01μF	72982	8121-M058-651-103M
C3	299240-2	2	CAPACITOR, ELECTROLYTIC, 22μF	31433	T368B226M015AS
C4	299241-200	2	CAPACITOR, MICA, 20pF	72136	DM5CC-200J
C5	299241-101	1	CAPACITOR, MICA, 100pF	72136	DM5FY101J
C6	299241-200		CAPACITOR, MICA, 20pF	72136	DM5CC-200J
C7	299240-2		CAPACITOR, ELECTROLYTIC, 22μF	31433	T368B226M015AS
C8	299245-2		CAPACITOR, CERAMIC, .01μF	72982	8121-M058-651-103M
C9	294079	1	CAPACITOR, ELECTROLYTIC, 56μF	56289	CSR13B566KM
E1	293306	5	TERMINAL	71279	1019-2-901
E2	293306		TERMINAL	71279	1019-2-901
E3	293306		TERMINAL	71279	1019-2-901
E4	293306		TERMINAL	71279	1019-2-901
E5	293306		TERMINAL	71279	1019-2-901
J5	299235	1	CONNECTOR, RIGHT ANGLE	98291	51-353-0000
L1	299237-26	2	INDUCTOR, 1.8μH	99800	1025-26
L2	299237-26		INDUCTOR, 1.8μH	99800	1025-26
Q1	294151	3	TRANSISTOR	04713	2N4124
Q2	294151		TRANSISTOR	04713	2N4124
Q3	294151		TRANSISTOR	04713	2N4124
R1	299700-622	2	RESISTOR, 6.2K, 1/8W, 5%	01121	RC05GF622J
R2	299700-301	1	RESISTOR, 300Ω, 1/8W, 5%	01121	RC05GF301J
R3	299700-242	2	RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
R4	299701-075	2	RESISTOR, 7.5Ω, 1/4W	01121	RC07GF7R5J
R5	299701-075		RESISTOR, 7.5Ω, 1/4W	01121	RC07GF7R5J
R6	299700-622		RESISTOR, 6.2K, 1/8W, 5%	01121	RC05GF622J

Table 5-1. Replaceable Parts List (Continued)

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1A2A2R7	299700-201	1	RESISTOR, 200Ω, 1/8W, 5%	01121	RC05GF201J
R8	299700-242		RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
R9	299700-101	1	RESISTOR, 100Ω, 1/8W, 5%	01121	RC05GF101J
R10	299700-203	1	RESISTOR, 20K, 1/8W, 5%	01121	RC05GF203J
R11	299700-103	1	RESISTOR, 10K, 1/8W, 5%	01121	RC05GF103J
R12	299700-391	1	RESISTOR, 390Ω, 1/8W, 5%	01121	RC05GF391J
U1	293520	2	INTEGRATED CIRCUIT	01295	74197
U2	293521	2	INTEGRATED CIRCUIT	04713	MC14040
U3	293520		INTEGRATED CIRCUIT	01295	74197
U4	293521		INTEGRATED CIRCUIT	04713	MC14040
XU1	294573	2	SOCKET, IC 14 PIN	01295	C931410
XU2	294567	2	SOCKET, IC 16 PIN	01295	C931610
XU3	294573		SOCKET, IC 14 PIN	01295	C931410
XU4	294567		SOCKET, IC 16 PIN	01295	C931610
1A2A3	295207	1	PHASE DETECTOR PC BOARD (Figure 4-12)	56872	295207
C1	299245-7	3	CAPACITOR, CERAMIC, 1μF	72982	8131-M058-651-105M
C2	299245-2	1	CAPACITOR, CERAMIC, .01μF	72982	8121-M058-651-103M
C3	299245-7		CAPACITOR, CERAMIC, 1μF	72982	8131-M058-651-105M
C4	299240-5	1	CAPACITOR, ELECTROLYTIC, 68μF	31433	T362C686M015AS
C5	299240-2	2	CAPACITOR, ELECTROLYTIC, 22μF	31433	T368B226M015AS
C6	299240-3	4	CAPACITOR, ELECTROLYTIC, 10μF	31433	T368B106M025AS
C7	299240-3		CAPACITOR, ELECTROLYTIC, 10μF	31433	T368B106M025AS
C8	299240-3		CAPACITOR, ELECTROLYTIC, 10μF	31433	T368B106M025AS
C9	299245-7		CAPACITOR, CERAMIC, 1μF	72982	8131-M058-651-105M
C10	299245-8	1	CAPACITOR, CERAMIC, .47μF	72982	8131-M050-651-474M
C11	299245-1	2	CAPACITOR, CERAMIC, .1μF	72982	8121-M058-651-104M
C12	299240-3		CAPACITOR, ELECTROLYTIC, 10μF	31433	T368B106M025AS
C13	299240-2		CAPACITOR, ELECTROLYTIC, 22μF	31433	T368B226M015AS
C14	299240-6	1	CAPACITOR, ELECTROLYTIC, 2.2μF	31433	T368B225M035AS
C15	299245-1		CAPACITOR, CERAMIC, .1μF	72982	8121-M058-651-104M
E1	293306	5	TERMINAL	71279	1019-2-901
E2	293306		TERMINAL	71279	1019-2-901
E3	293306		TERMINAL	71279	1019-2-901
E4	293306		TERMINAL	71279	1019-2-901
E5	293306		TERMINAL	71279	1019-2-901
R1	299700-103	2	RESISTOR, 10K, 1/8W, 5%	01121	RC05GF103J
R2	299700-101	4	RESISTOR, 100Ω, 1/8W, 5%	01121	RC05GF101J
R3	299700-101		RESISTOR, 100Ω, 1/8W, 5%	01121	RC05GF101J
R4	299700-101		RESISTOR, 100Ω, 1/8W, 5%	01121	RC05GF101J
R5	299700-201	2	RESISTOR, 200Ω, 1/8W, 5%	01121	RC05GF102JS
R6	299700-471	2	RESISTOR, 470Ω, 1/8W, 5%	01121	RC05GF471JS
R7	299700-201	2	RESISTOR, 1.8K, 1/8W, 5%	01121	RC05GF182JS
R8	299700-201		RESISTOR, 200Ω, 1/8W, 5%	01121	RC05GF201JS
R9	299700-471		RESISTOR, 470Ω, 1/8W, 5%	01121	RC05GF471JS
R10	299700-182		RESISTOR, 1.8K, 1/8W, 5%	01121	RC05GF182JS
R11	299700-242	2	RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
R12	299700-242		RESISTOR, 2.4K, 1/8W, 5%	01121	RC05GF242J
R13	294051	1	RESISTOR, VARIABLE, 100K	80294	3262W-1-104
R14	299700-104	2	RESISTOR, 100K, 1/8W, 5%	01121	RC05GF104J
R15	299700-302	1	RESISTOR, 3K, 1/8W, 5%	01121	RC05GF302J
R16	299700-103		RESISTOR, 10K, 1/8W, 5%	01121	RC05GF103J
R17	299700-104		RESISTOR, 100K, 1/8W, 5%	01121	RC05GF104J
R18	299700-391	1	RESISTOR, 390Ω, 1/8W, 5%	01121	RC05GF391J
R19	299700-101		RESISTOR, 100Ω, 1/8W, 5%	01121	RC05GF101J
TP1	294431	1	CONNECTOR, TEST	71279	450-3754-02-03
U1	293355	1	INTEGRATED CIRCUIT	01295	76514N
U2	296007	1	INTEGRATED CIRCUIT	06665	OP14CJ
XU1	294573	1	SOCKET, IC 14PIN	01295	C931410

Table 5-1. Replaceable Parts List (Continued)

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1A3	295238	1	BEZEL ASSEMBLY (Figure 4-13)	56872	295238
M1	295229	1	METER	98999	1MW5-DMA-001-RF-CP2
R1	294046	1	RESISTOR, VARIABLE 1K, 10%	01121	70B1G031R102W
R2	299700-102	4	RESISTOR, 1K, 1/8W, 5%	01121	RCR05G102JS
R3	299700-102		RESISTOR, 1K, 1/8W, 5%	01121	RCR05G102JS
R4	299700-102		RESISTOR, 1K, 1/8W, 5%	01121	RCR05G102JS
R5	299700-102		RESISTOR, 1K, 1/8W, 5%	01121	RCR05G102JS
S1	295239	3	SWITCH, MODIFIED	76854	5-17837-412
S2	295239		SWITCH, MODIFIED	76854	5-17837-412
S3	295239		SWITCH, MODIFIED	76854	5-17837-412
W7	299297-54	1	CABLE ASSEMBLY, COAXIAL	56872	299297-54
W10	299297-57	1	CABLE ASSEMBLY, COAXIAL	56872	299297-57
W11	299297-58	1	CABLE ASSEMBLY, COAXIAL	56872	299297-58
1A4	295234		CONTROL ASSEMBLY (Figure 4-14)	56872	295234
C1	299241-360	2	CAPACITOR, DIPPED MICA, 36pF	72136	DM5EC-360J
C2	299241-360		CAPACITOR, DIPPED MICA, 36pF	72136	DM5EC-360J
C3	299241-270	2	CAPACITOR, DIPPED MICA, 27pF	72136	DM5EC-270J
C4	299240-4	2	CAPACITOR, TANTALUM, 100μF	31433	T362D107M020AS
C5	299241-270		CAPACITOR, DIPPED MICA, 27pF	72136	DM5EC-270J
C6	299240-4		CAPACITOR, TANTALUM, 100μF	31433	T362D107M020AS
C7	299241-680	1	CAPACITOR, DIPPED MICA, 68pF	72136	DM5EY-680J
C8	299240-2	3	CAPACITOR, TANTALUM, 22μF, 15V	31433	T368B226M015AS
C9	299240-1	1	CAPACITOR, TANTALUM, 6.8μF, 35V	31433	T368B225M035AS
C10	299250-121	1	CAPACITOR, DIPPED MICA, 120pF	14655	CM04FD121J03
C11	299240-2		CAPACITOR, TANTALUM, 22μF, 15V	31433	T368B226M015AS
C12	299240-2		CAPACITOR, TANTALUM, 22μF, 15V	31433	T368B226M015AS
C13	299245-2	3	CAPACITOR CERAMIC, .01μF	72982	8121-M058-651-103M
C14	299245-2		CAPACITOR CERAMIC, .01μF	72982	8121-M058-651-103M
C15	299245-2		CAPACITOR CERAMIC, .01μF	72982	8121-M058-651-103M
CR1	299251-1	15	DIODE	72314	IN4009
CR2	299251-1		DIODE	72314	IN4009
CR3	299251-1		DIODE	72314	IN4009
CR4	299251-1		DIODE	72314	IN4009
CR5	299251-1		DIODE	72314	IN4009
CR6	299251-1		DIODE	72314	IN4009
CR7	299251-1		DIODE	72314	IN4009
CR8	299251-1		DIODE	72314	IN4009
CR9	299251-1		DIODE	72314	IN4009
CR10	299251-1		DIODE	72314	IN4009
CR11	299251-1		DIODE	72314	IN4009
CR12	299251-1		DIODE	72314	IN4009
CR13	299251-1		DIODE	72314	IN4009
CR14	299251-1		DIODE	72314	IN4009
CR15	299251-1		DIODE	72314	IN4009
J1	294426	3	CONNECTOR, RF, SNAP ON JACK	98291	51-051-0000
J2	294426		CONNECTOR, RF, SNAP ON JACK	98291	51-051-0000
J3	294426		CONNECTOR, RF, SNAP ON JACK	98291	51-051-0000
J4	299932	1	HEADER, 26 PIN, STRAIGHT	00779	1-87227-3
K1	294196	3	RELAY, SPST	32590	2160S-5
K2	294197	4	RELAY, SPDT	32590	2275-5
K3	294197		RELAY, SPDT	32590	2275-5
K4	294197		RELAY, SPDT	32590	2275-5
K5	294198	1	RELAY, SPST	32590	2172-5
K6	294196		RELAY, SPST	32590	2160S-5
K7	294197		RELAY, SPDT	32590	2275-5
K8	294196		RELAY, SPST	32590	2160S-5
R1			NOT USED		
R2			NOT USED		
R3			NOT USED		
R4			NOT USED		
R5	299700-102	2	RESISTOR, 1K, 1/8W, 5%	01121	RC05GF102J

Table 5-1. Replaceable Parts List (Continued)

Reference Designation	AILTECH Part Number	Qty	Description	Mfr Code	Mfr Part Number
1A4R6	294055	1	RESISTOR VARIABLE, 25K	80294	3262W-1-253
R7	299708-403	1	RESISTOR, 6.49K, 1/8W, 1%	01121	RN55D6491F
R8	299708-500	1	RESISTOR, 64.9K, 1/8W, 1%	01121	RN55D6492F
R9	299708-361	1	RESISTOR, 2.55K, 1/8W, 1%	01121	RN55D2551F
R10	299700-103	1	RESISTOR, 10K, 1/8W, 5%	01121	RC05GF103J
R11	299700-362	3	RESISTOR, 3.6K, 1/8W, 5%	01121	RC05GF362J
R12			NOT USED		
R13	299700-201	2	RESISTOR, 200Ω, 1/8W, 5%	01121	RC05GF201J
R14	299700-201		RESISTOR, 200Ω, 1/8W, 5%	01121	RC05GF201J
R15	299700-203	3	RESISTOR, 20K, 1/8W, 5%	01121	RC05GF203J
R16	299700-203		RESISTOR, 20K, 1/8W, 5%	01121	RC05GF203J
R17	299700-680	2	RESISTOR, 68Ω, 1/8W, 5%	01121	RC05GF680J
R18	299700-680		RESISTOR, 68Ω, 1/8W, 5%	01121	RC05GF680J
R19	299700-362		RESISTOR, 3.6K, 1/8W, 5%	01121	RC05GF362J
R20	299700-362		RESISTOR, 3.6K, 1/8W, 5%	01121	RC05GF362J
R21	299708-322	1	RESISTOR, 1K, 1/8W, 1%	01121	RN55D1001F
R22	299708-451	3	RESISTOR, 20K, 1/8W, 1%	01121	RN55D2002F
R23	299700-102		RESISTOR, 1K, 1/8W, 5%	01121	RC05GF102J
R24	299700-203		RESISTOR, 20K, 1/8W, 5%	01121	RC05GF203J
R25	299708-451		RESISTOR, 20K, 1/8W, 1%	01121	RN55D2002F
R26	299700-103	2	RESISTOR, 10K, 1/8W, 5%	01121	RC05GF103J
R27	299708-451		RESISTOR, 20K, 1/8W, 1%	01121	RN55D2002F
R28	299700-103		RESISTOR, 20K, 1/8W, 5%	01121	RC05GF103J
R29	299701-471	1	RESISTOR, 470Ω, 1/4W, 5%	01121	RC07GF471J
R30	294093	1	RESISTOR VARIABLE, 1K	80294	3262W-1-102
R31	299700-822	1	RESISTOR, 8.2K, 1/8W, 5%	01121	RC05GF822JS
R32	299700-075	4	RESISTOR, 7.5Ω, 1/8W, 5%	01121	RC05GF7R5J
R33	299700-075		RESISTOR, 7.5Ω, 1/8W, 5%	01121	RC05GF7R5J
R34	299708-480	1	RESISTOR, 40.2K, 1/8W, 1%	01121	RN55D4022F
R35	294092	1	RESISTOR VARIABLE, 10K	80294	3262-W-1-103
R36	299700-075		RESISTOR, 7.5Ω, 1/8W, 5%	01121	RC05GF7R5J
R37	299700-075		RESISTOR, 7.5Ω, 1/8W, 5%	01121	RC05GF7R5J
R38	294053	1	RESISTOR VARIABLE, 500Ω	80294	3262-W-1-501
U1	295275	1	INTEGRATED CIRCUIT	34371	HM-7603-5-5275
U2	293414	1	INTEGRATED CIRCUIT	01295	74157N
U3	293514	2	INTEGRATED CIRCUIT	24355	AD7520JN
U4	295276	1	INTEGRATED CIRCUIT	34371	HM7602-5-5276
U5	293515	3	INTEGRATED CIRCUIT	34371	HA12625-5
U6	293514		INTEGRATED CIRCUIT	24355	AD7520JN
U7	293515		INTEGRATED CIRCUIT	34371	HA12625-5
U8	293516	1	INTEGRATED CIRCUIT	18324	N5556V
U9	293517	2	INTEGRATED CIRCUIT	72314	UA715DC
U10	293517		INTEGRATED CIRCUIT	72314	UA715DC
U11	293515		INTEGRATED CIRCUIT	34371	HA12625-5
U12	293354	2	INTEGRATED CIRCUIT	18324	UA741CV
U13	293354		INTEGRATED CIRCUIT	18324	UA741CV
XU1	294567	5	IC SOCKET 16 PIN	01295	931610
XU2	294567		IC SOCKET 16 PIN	01295	931610
XU3	294567		IC SOCKET 16 PIN	01295	931610
XU4	294567		IC SOCKET 16 PIN	01295	931610
XU5	294573	5	IC SOCKET 14 PIN	01295	931410
XU6	294567		IC SOCKET 16 PIN	01295	931610
XU7	294573		IC SOCKET 14 PIN	01295	931410
XU8	294565	3	IC SOCKET 8 PIN	01295	930810
XU9	294573		IC SOCKET 14 PIN	01295	931410
XU10	294573		IC SOCKET 14 PIN	01295	931410
XU11	294573		IC SOCKET 14 PIN	01295	931410
XU12	294565		IC SOCKET 8 PIN	01295	930810
XU13	294565		IC SOCKET 8 PIN	01295	930810

Table 5-2. Federal Supply Code Manufacturer

Vendor Code	Manufacturer	Address
00779	Amp Inc.,	Box 3608, Harrisburg, PA 17105
01121	Allen-Bradley Co.,	1201 South Second Street, Milwaukee, WI 53204
01295	Texas Instruments, Inc.,	Box 225012-MS-84, Dallas, TX 75265
04713	Motorola Inc.,	Syracuse, NY 13201
06665	Precision Monolithics, Inc.,	1500 Space Drive, Santa Clara, CA 95050
11532	Teledyne Relays	12525 Daphne Avenue, Hawthorne, CA 90250
14655	Cornell-Dubilier Electronics	150 Avenue L, Newark, NJ 07105
18324	Signetics Corp.	811 East Arques Avenue, Sunnyvale, CA 94086
18518	MSI Electronics Inc.,	34-32 57th Street, Woodside, NY 11377
24355	Analog Devices Inc.,	PO Box 280, Norwood, MA 02062
29990	American Technical Ceramics	1 Norden Lane, Huntington Station, NY 11746
31433	Kemet, Union Carbide Corp. Electrns Div.,	Box 5928, Greenville, SC 29606
32590	Electrical Instrument Service, Inc.,	25 Dock Street, Mount Vernon, NY 10550
34371	Harris Semiconductor	PO Box 883, Melbourne, FL 32901
50436	Hewlett-Packard Co.	1501 Page Mill Road, Palo Alto, CA 94304

Table 5-2. Federal Supply Code Manufacturer (Continued)

Vendor Code	Manufacturer	Address
52648	Plessey Semiconductors	1641 Kaiser Avenue, Irvine, CA 92714
56289	Sprague Products Co.,	481 Marshall Street, North Adams, MA 01247
56872	Eaton Corporation Electronic Instrumentation Division	2070 Fifth Avenue, Ronkonkoma, NY 11779
71279	Cambridge Thermionic Corp.	445 Concord Avenue, Cambridge, MA 02138
72136	Electro Motive Mfg., Co.,	Williamantic, CT 06226
72314	Fairchild Camera and Instrument Corp.,	464 Ellis Street, Mountain View, CA 94042
72982	Erie Technological Products	PO Box 961, Erie, PA 16512
76854	Oak Technology Inc.,	Dept. DA, Crystal Lake, IL 60014
80294	Bourns Instruments, Inc.	6135 Magnolia, Riverside, CA 92506
91293	Johanson Mfg., Corp.,	400 Rockaway Valley Road, Boonton, NJ 07005
95275	Vitramon Inc.,	PO Box 544, Bridgeport, CT 06601
98291	Sealectro Corp.	225 Hoyt Street Mamaroneck, NY 10543
98999	Modutec Inc.,	18 Marshall Street Norwalk, CT 06854
99800	Delevan Division American Prec Inds.	270 Quaker Road, East Aurora, NY 14052

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